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Final Report

# A STUDY OF COMFORT, HEALTH AND LEARNING IN SCHOOLS WITH DIFFERING THERMAL CONDITIONS

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The ~~principal~~ objective was to obtain ~~reliable~~ data on the effects of thermal conditions on comfort (teacher and students), class behavior, student test performance and health (visits to health room and absences) in both climate controlled and non-climate controlled schools. Data were collected by teachers in three classrooms of each of six schools--two grade schools, ~~East Gresham and Powell Valley in Gresham,~~ two junior high schools, ~~Gardiner and Ogden in Oregon City,~~ and two high schools. Milwaukie and Rex Putnam in the city of Milwaukie. The second named school of each pair of schools was climate controlled. Data were collected from classes taking spelling (6th grade), social studies (7-8th grade), Spanish (8-9th grade), Latin (10,11, 12th grade), general math(10, 11th grade) and geometry (11, 12th grade). Teachers participating in the project were paid a small honorarium. In general, the design approach was to conduct all quantitative analyses "within" schools, and, as appropriate, to treat the air-conditioned schools as the "control group" for evaluating relationships between behavioral measures and temperature observed in the non-climate controlled schools. In general, students and (cont'd on attached sheet)

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teachers in climate controlled schools are comfortable much more of the time than their counterparts in the non-climate controlled schools, but that they become more sensitive to small changes in classroom temperature. Students in non-climate controlled schools tend to work less well in periods of hot weather when their classrooms are unusually warm. The academic performances of students in climate controlled schools are also affected by variations in temperature, but they seem to be more influenced by the contrast between inside and outside temperature than by variations in their classroom temperatures. Fluctuations in temperature in Spring and Fall did not appear to affect the health of students in these six schools in the Pacific Northwest.

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# A STUDY OF COMFORT, HEALTH AND LEARNING IN SCHOOLS WITH DIFFERING THERMAL CONDITIONS

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31 August 1970

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We are especially grateful to the Portland General Electric Company for the indispensable support which they gave to this project, for providing and maintaining thermograph recorders in the eighteen classrooms and regularly collecting and mailing the classroom and ambient thermal environment data to Dunlap and Associates, Inc., for analysis. In particular, we are most grateful to Mr. Chester W. Jarrett of PGE for his initiative in proposing the Portland area as the location for a "School" study, for his help in planning and setting up the data collection procedures in the schools and for his continuing interest and active support throughout the study.

Finally, the authors wish to thank the chairman and members of the ASHRAE Sub-Committee RP-91 for their encouragement, advice and support, and the National Air Pollution Control Administration for supporting Phase 2 of the project.

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# I. INTRODUCTION

This report describes the work performed and the main findings from an ASHRAE, Oregon State Department of Education and NAPCA joint research project conducted during Spring and Fall, 1969, in six public schools in suburban communities near Portland, Oregon.

The objectives, scope and data collection procedures were the same for both the Spring and Fall phases of the project. Briefly, the principal objective ~~of the study~~ was to obtain reliable data on the effects of thermal conditions on comfort (teacher and students), class behavior, student test performance and health (visits to health room and absences) in both climate controlled and non-climate controlled schools. Data were collected by teachers in three classrooms of each of six schools--two grade schools, East Gresham and Powell Valley in Gresham, two junior high schools, Gardiner and Ogden in Oregon City, and two high schools, Milwaukie and Rex Putnam in the city of Milwaukie. The second named school of each pair of schools was climate controlled. Data were collected from classes taking spelling (6th grade), social studies (7-8th grade), Spanish (8-9th grade), Latin (10, 11, 12th grade), general math (10, 11th grade) and geometry (11, 12th grade). Teachers participating in the project were paid a small honorarium. In general, the design approach was to conduct all quantitative analyses "within" schools, and, as appropriate, to treat the air-conditioned schools as the "control group" for evaluating relationships between behavioral measures and temperature observed in the non-climate controlled schools.

A project secretary was hired for each school to assist the teachers, school nurse and attendance secretary in collecting data. She acted as a project data center for each school, distributed blank forms, collected completed forms, tabulated the raw data and every week mailed the data to Dunlap and Associates, Inc., for analysis. Detailed written instructions were provided for the teachers, nurses and project secretaries, and data reporting forms were prepared and mailed to each school. Sample copies of these instructions are attached (Appendix I).

to p. 54

This report of the study is organized around a number of sections or chapters each of which relates primarily to one type of data; namely, inside and outside thermal measurements, ratings of comfort and class behavior, performance scores on tests of course material and records of student "sickness" and absences.

Each section describes the methods of data collection and analysis and the main findings. The final section of the report summarizes and discusses the principal findings and conclusions.

# II. MEASUREMENTS OF THE THERMAL ENVIRONMENT

## A. Introduction

A study of the effects of air temperature on teachers and students in classrooms in both climate controlled and other schools was conducted in suburban communities near Portland, Oregon. A number of factors determined the location of the study in the Portland area. An important consideration was the temperate climate of the Pacific Northwest. Many uninformed people might be surprised by the relatively large number of climate controlled schools already in the area, and by the fact that in order to maintain comfortable temperatures in many classrooms, mechanical cooling is necessary whenever the outside temperature exceeds about 55° F. Consequently, we felt that evidence of the effects of classroom temperatures on teachers and students in such a temperate region could perhaps have greater significance for schools throughout the country than similar evidence from very warm parts of the country. The design of the study called for the collection of thermal measurement data both inside and outside the schools participating in the study.

## B. Data Collection Procedures

Measurements of the ambient or outside thermal conditions were obtained from two sources; a seven-day thermograph recorder located outside Ogden Junior High School in Oregon City and the U.S. Department of Commerce monthly publication, "Local Climatological Data," for Portland, International Airport and Salem, McNary Field, Oregon.

The daily maximum outside air temperatures for Gardiner and Ogden Junior High Schools in Oregon City were taken from the outside recorder at Ogden. The daily maximum outside air temperatures for East Gresham and Powell Valley Grade Schools in Gresham were taken from the "Local Climatological Data" for Portland, International Airport, which experiences similar local climatic conditions to Gresham. The daily maximum outside air temperatures for Milwaukie and Rex Putnam High Schools in Milwaukie were taken as the average of the daily maximum temperatures reported for Portland and Salem airports. Milwaukie lies south of Portland airport in the direction of Salem and away from the influence of the Columbia River and the Columbia River Gorge.

Measurements of indoor temperature and relative humidity in all 18 classrooms included in the study were recorded continuously on seven-day hygro-thermograph recorders. These instruments were supplied, installed, calibrated and serviced weekly by the Portland General Electric Company.

Copies of the thermograph records were mailed weekly to Dunlap and Associates, Inc., for use in the analyses. The average air movement in the classrooms in the climate controlled schools was estimated to be the design value of 25-30 feet per minute, and in the other schools, where classroom windows and doors were generally left open to obtain maximum cross ventilation, the average air movement was estimated as 100 feet per minute.'

### C. General Characteristics of the Thermal Environment

The weather during the Spring and Fall phases of the project differed very markedly. In Phase I, in the Spring, temperatures ranged from a weekly average maximum of about 55° in the last week of April through a succession of weeks in the middle of May when the weekly averages were 75-80° F. The weather during most of Phase II, in the Fall, was disappointingly cool. The only spell of really high temperatures occurred right at the start of Phase II during the week of 8 September before most schools had started collecting behavioral data. For the remainder of Phase II, there was a generally consistent decrease in outside temperatures from week to week.

The weekly averages and ranges in maximum outside temperature for the three communities throughout Phases I and II are plotted in Figures 1 and 2. The daily averages of the 2:00 p.m. dry bulb temperatures of the three classrooms in each of the three non-climate controlled and three climate controlled schools during May and a one-month period in the Fall are plotted in Figures 3 and 4, 5 and 6, respectively. These charts of daily maximum outside temperatures in each community and average classroom temperatures in each school show the general trends in daily temperatures during the two phases of the study. They also show, to a limited extent, the differences in thermal conditions between the climate controlled and other schools in the Spring and Fall. In particular, it is important to note that over much of the period of data collection in Phase II there was little difference in average inside temperatures between the climate controlled and the other three schools, except that the temperatures in Gresham Grade School were allowed to fall over the period more than in the other schools. In fact, in contrast to the conditions in Phase I, the classroom air temperatures during Phase II in East Gresham Grade School were generally lower than in its comparison climate controlled Powell Valley Grade School. Notice also that in Phase I, control of the classroom temperatures in Rex Putnam High School was considerably less well maintained than in the other two climate controlled schools. However, in Phase II the degree of control in Rex Putnam was much improved.

Figure 1

AVERAGE OUTSIDE TEMPERATURE AND RANGE FOR EACH WEEK

(April 7 - June 6)

Phase I

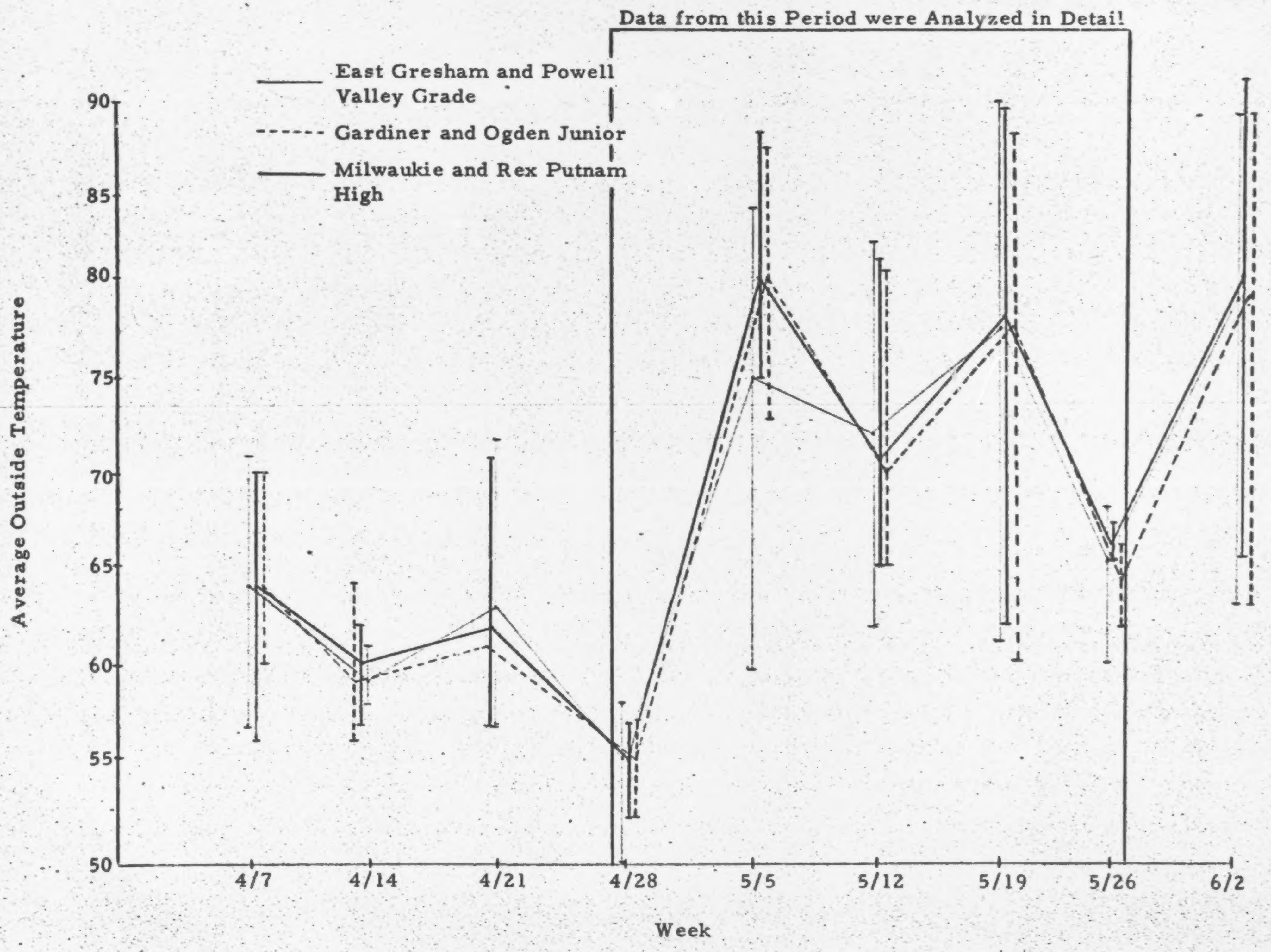


Figure 2
AVERAGE OUTSIDE TEMPERATURE AND RANGE FOR EACH WEEK
(September 8 - November 3)
Phase II

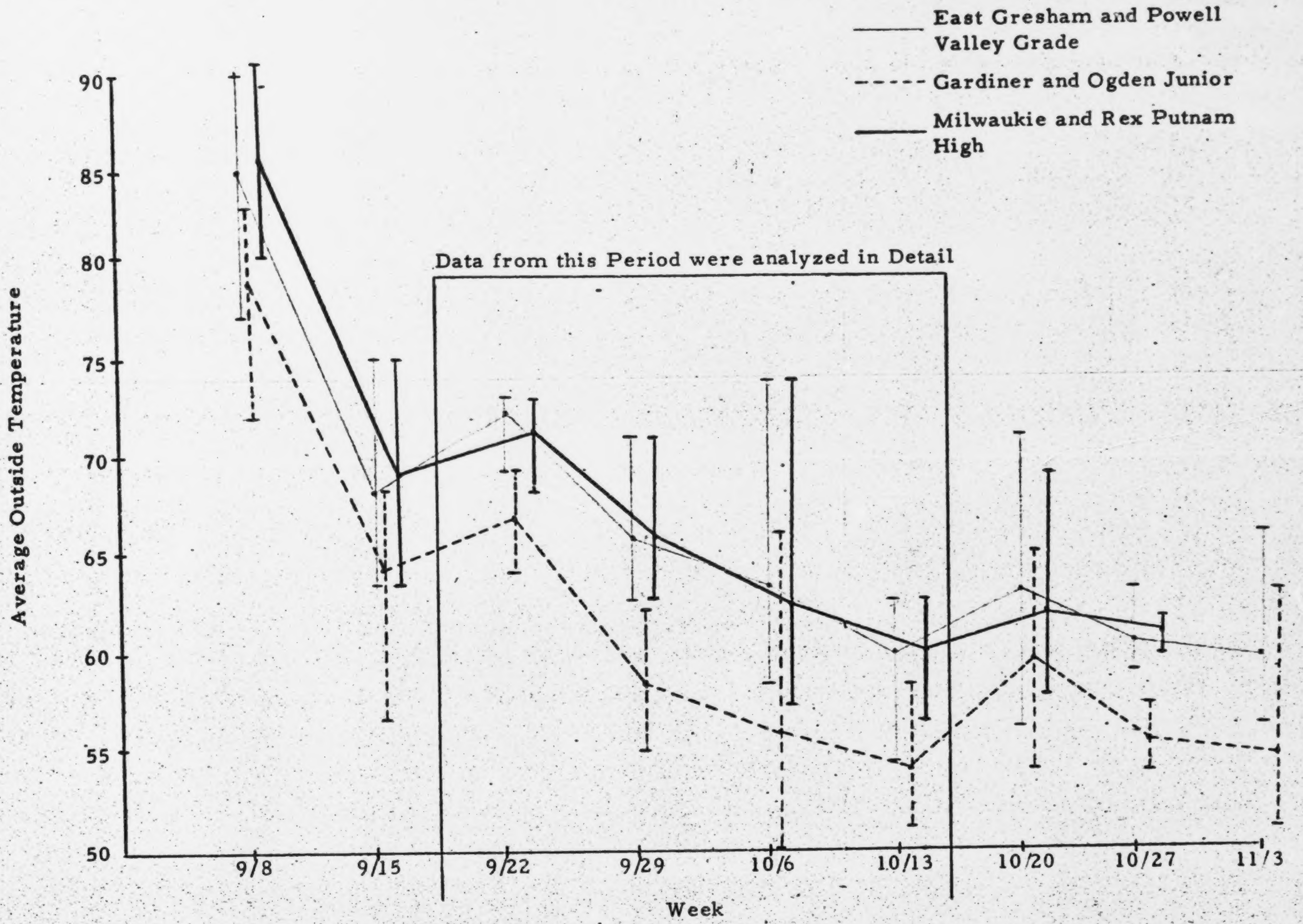
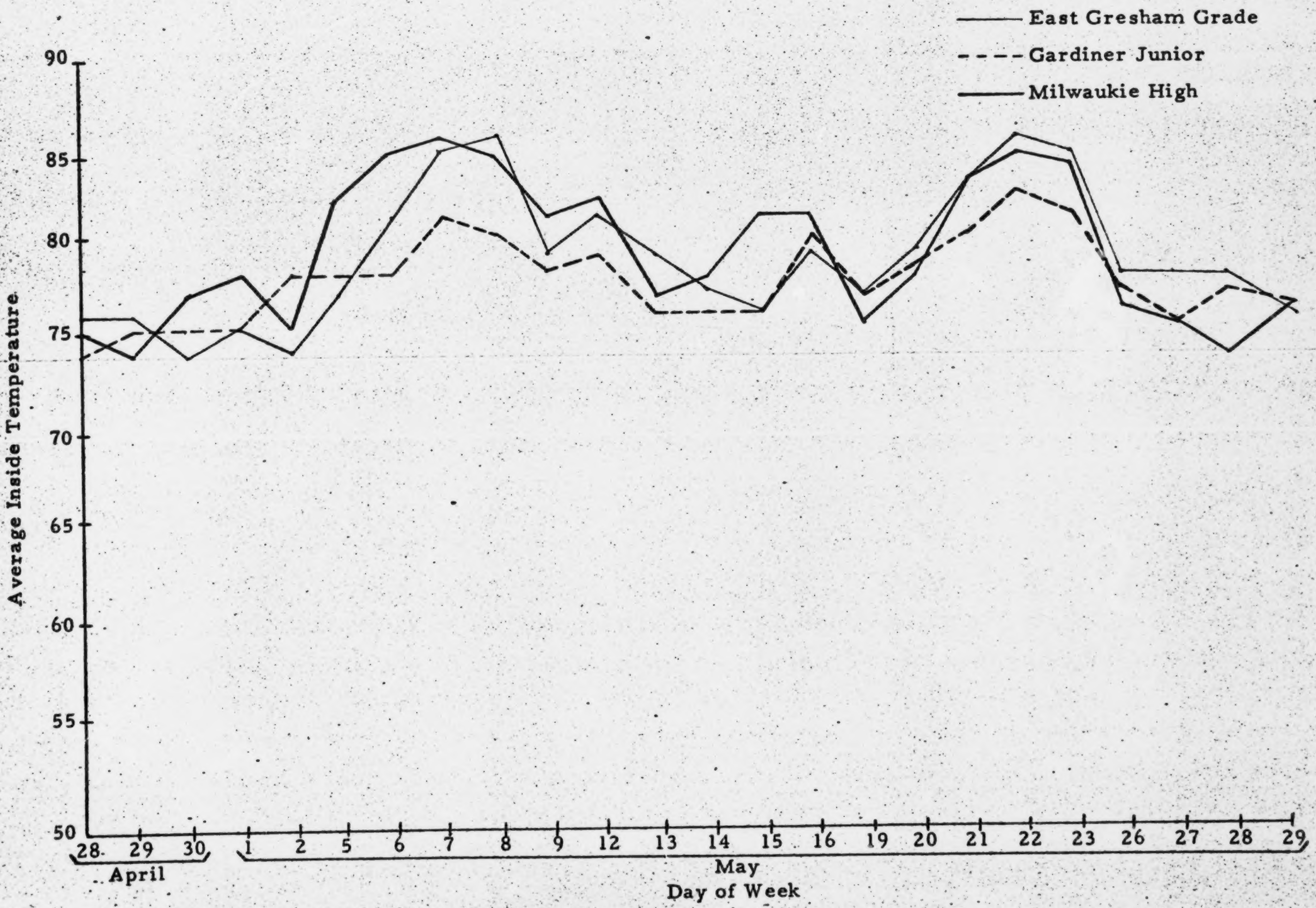


Figure 3

DAILY AVERAGE INSIDE DRY BULB TEMPERATURE--
NON-CLIMATE CONTROLLED SCHOOLS
April 28 - May 29
Phase I



## Figure 4
## DAILY AVERAGE INSIDE DRY BULB TEMPERATURE--CLIMATE CONTROLLED SCHOOLS
April 28 - May 29
Phase I

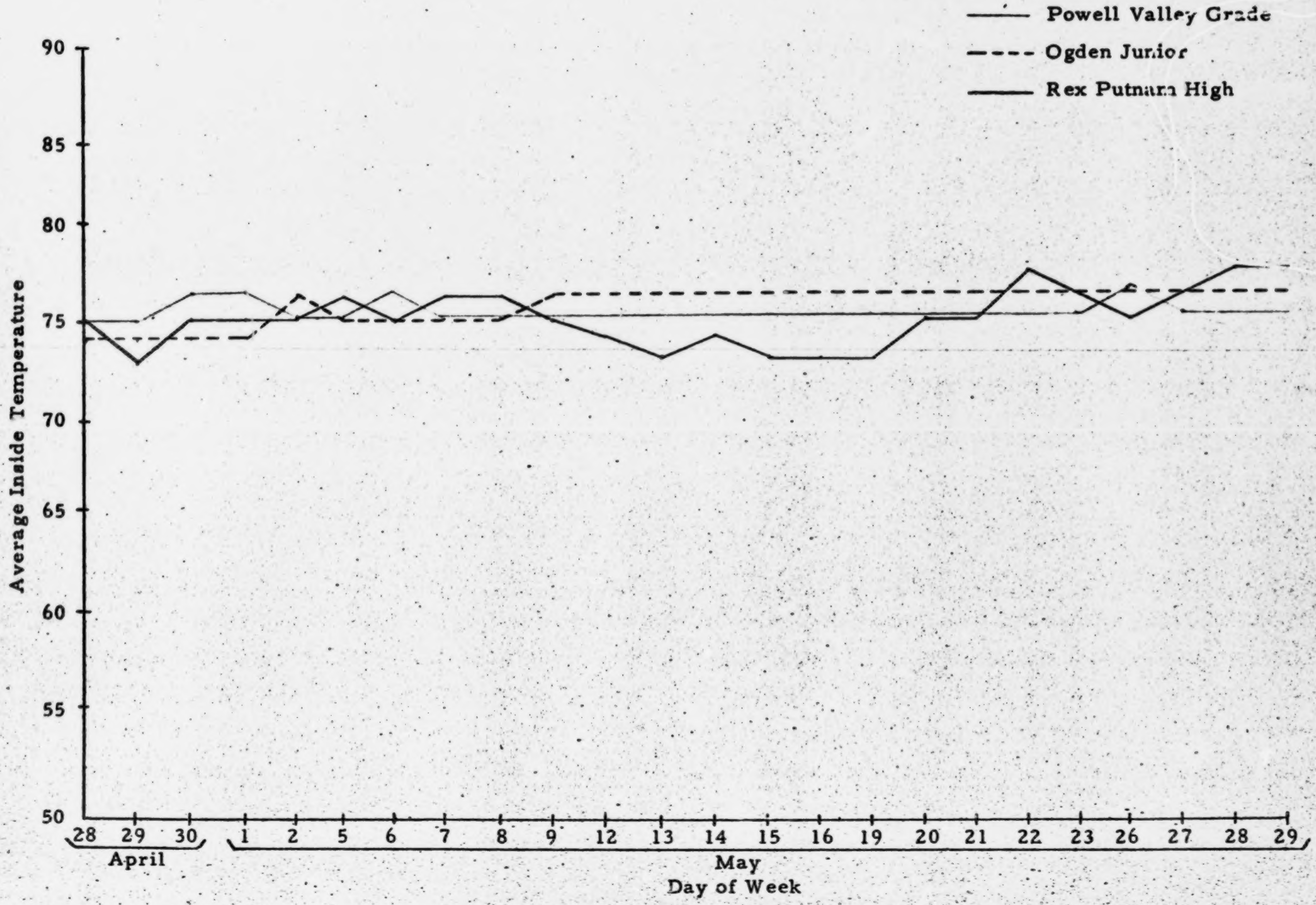
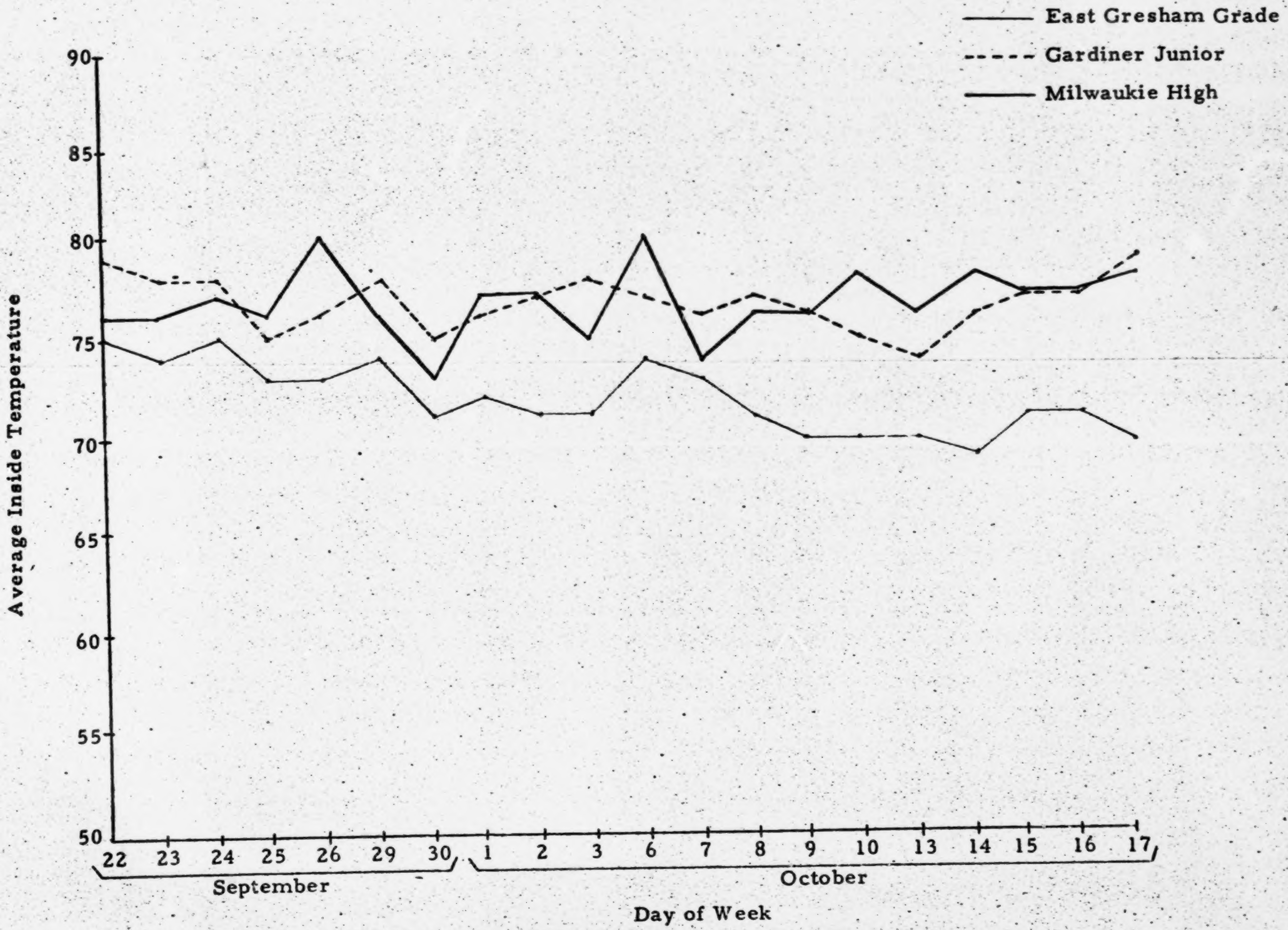


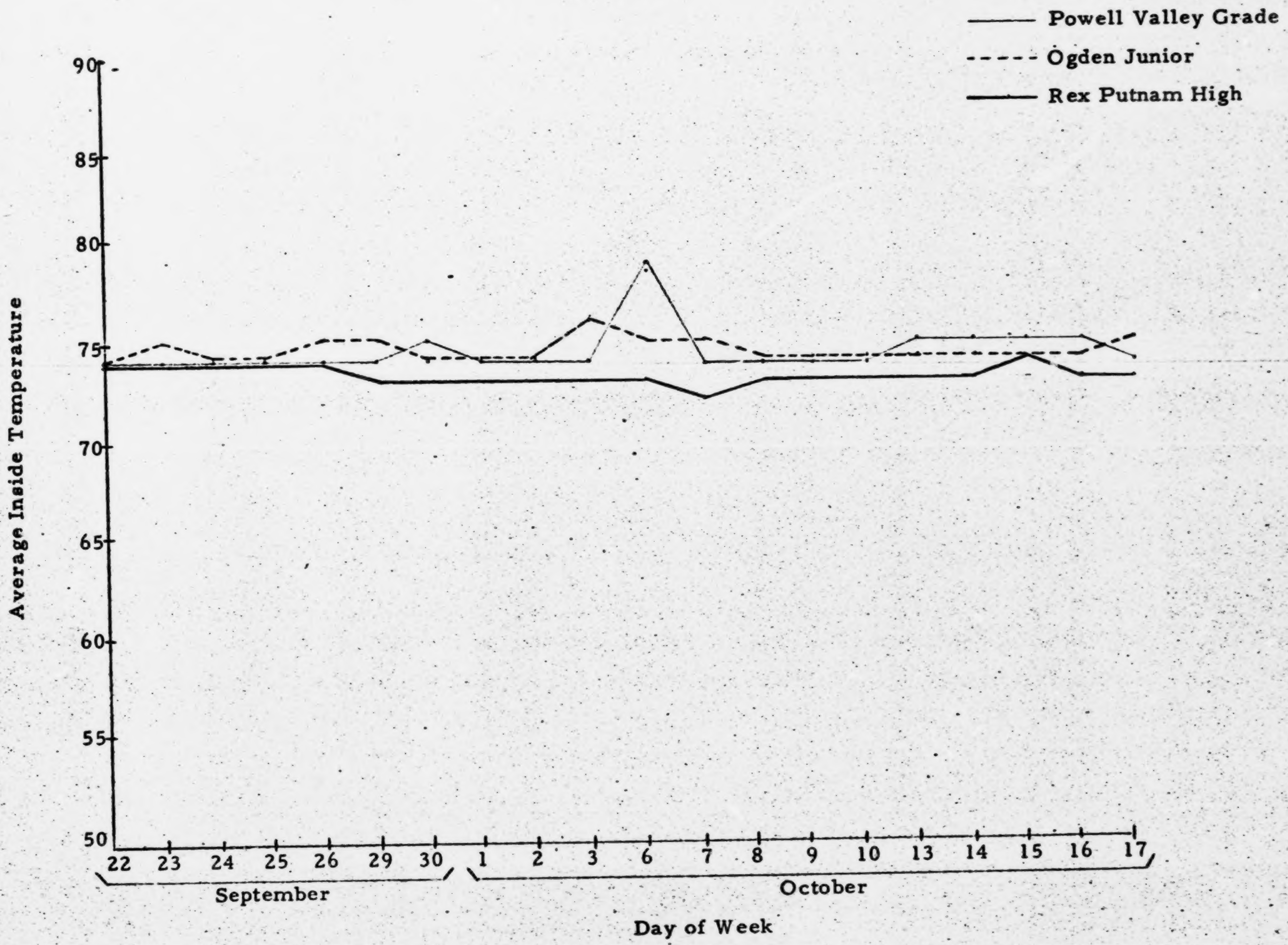
Figure 5

DAILY AVERAGE INSIDE DRY BULB TEMPERATURE--
NON-CLIMATE CONTROLLED SCHOOLS
(One-Month Period - September 22-October 17)
Phase II



## Figure 6

## DAILY AVERAGE INSIDE DRY BULB TEMPERATURE--
## CLIMATE CONTROLLED SCHOOLS
(One-Month Period - September 22-October 17)
Phase II



# III. RATINGS OF THERMAL COMFORT AND CLASS BEHAVIOR

## A. Introduction

The belief is widespread that people feel better, work better and are also healthier when they live and work in a comfortable climate, and are exposed only rarely to uncomfortably cold or hot conditions. For years, the air conditioning industry has been acting in this belief and provided buildings that are designed for human comfort. A considerable body of information has been accumulated over the past 30 to 40 years on the ranges of thermal conditions within which people are most likely to feel comfortable (Ref. ASHRAE Guide, 1967). This information has been obtained from both laboratory studies (generally on young adults) over carefully controlled ranges of a limited number of environmental variables, and field studies in a number of cities in North America, mainly on office workers of both sexes and differing in age. The ASHRAE Standard 55-66, "Thermal Comfort Conditions," specifies 75°F dry bulb and 40% relative humidity as the central recommendation when mean radiant temperature equals air temperature. Studies in the ASHRAE laboratory (Koch, Jennings and Humphrey, 1960) indicated optimum conditions for comfort in winter and summer to be about 77° and 78°F, respectively. More recent studies at Kansas State University (McNall, Ryan and Jaax, 1968) found no differences between male and female and winter and summer comfort data, with a typical preferred condition of 78°F dry bulb and 50% relative humidity. The K.S.U. authors comment that the approximate 3°F difference between the laboratory findings and the preferred temperature in practical environments could be due to differences in levels of physical activity and in clothing. Field surveys of the comfort of office workers generally found that preferred conditions for female workers were at least 1°F higher than for men. This difference between comfort conditions for the sexes in practical situations could also be due to differences in clothing.

A preliminary study of learning and classroom comfort conducted by the Iowa Center for Research in School Administration (Peccolo, 1962) indicated that in an "ideal" classroom sixth grade girls reported feeling too cool significantly more often than boys in the class, and all students indicated feeling cool or cold more frequently in the mornings despite a constant classroom environment. In an experiment in schools in Pinellas County, Florida (Stuart and Curtis, 1964), the students in non-climate controlled schools generally reported they were comfortable at higher temperatures than students in climate controlled schools.

The objective for collecting thermal comfort data in the present study was to determine what temperatures of the classrooms were reported to be comfortable by teachers and students, at different grade levels in both climate controlled and non-climate controlled schools. A more general objective was to see whether the comfortable or "neutral" (neither warm nor cool) temperature would differ between teachers and students, male and females, morning and afternoon classroom periods, schools at different grade levels, climate controlled and other schools and between Spring and Fall.

## B. Data Collection Procedures

Thermal comfort ratings were obtained toward the end of all periods of instruction in selected courses held in three classrooms (equipped with hygro-thermographs) in two grade schools, two junior high schools and two high schools. Ratings were recorded by each student and teacher every day of the week throughout the nine weeks of the fourth marking period in the Spring and the first marking period in the Fall. The total number of ratings of thermal comfort recorded was approximately 50,000 in both the Spring and Fall.

Students were instructed by their teachers at the beginning of each Phase of the study in how to fill out the rating scale forms and to return them for collection at the ends of every period. They were asked to indicate how they felt by circling one number on a seven -point thermal sensation scale ranging from (1) Cold through (4) Neither warm nor cool, to (7) Hot. A sample of the rating scale form is shown in Figure 7. Every time a class completed their rating forms, the teacher also completed a similar form. Teachers were provided with written instructions about the study, about what they were asked to do and specific procedures for instructing their students in the proper use of the thermal comfort rating scale (copies of these sets of instructions are attached, Appendix I).

Teachers were also asked to report at the end of each class how "responsive" the class had been. They were asked to scale their judgments by circling one number on a nine-point scale of "responsiveness" that ranged from 9, very high, through 5, average to 1, very low. A sample of the Class Behavior Rating Form is shown in Figure 8. Written instructions for using this second rating scale were also provided the three teachers at each school participating in the study (copies of the instructions to teachers for using the Class Behavior Rating Form are attached, Appendix I).

## C. Methods of Analysis

Detailed statistical analyses were performed on approximately one half of all the data recorded. Because of the large amounts of data collected by our standardized procedures (instituted in each of the six schools and

## THERMAL COMFORT SCALE

Name ______________________________ Room No. ____________________

Date ______________________________ Time ____________________

Circle the number that describes how you feel now.

1. Cold
2. Cool
3. Slightly cool
4. Neither warm nor cool
5. Slightly warm
6. Warm
7. Hot

Signed: ______________________

Figure 7. Thermal Comfort Rating Scale

## RATING OF CLASS BEHAVIOR

**Teacher's Name** ____________________ **Date** ____________________

**Class Period** ____________________ **Time** ____________________

**Class responsiveness was:** **(Circle One)**

| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|
| **very high** | | **high** | | **average** | | **low** | | **very low** |

**Any unusual circumstances:** ________________________________________

____________________________________________________________

____________________________________________________________

**Teacher's Signature:**

____________________

Figure 8. Class Behavior Rating Form

followed routinely throughout each of the two nine-week marking periods) and the relatively high cost of data reduction, we concentrated our analyses on data from periods differing the most in temperature.

Detailed analyses were conducted on data collected over selected four-five week periods. In Phase I, this period ran from April 28-May 29, and in Phase II, it was the first month during which all six schools were recording behavioral data and extended from September 22 to October 17. In each grade school, rating data from the three classes of sixth graders were analyzed both separately and combined. At the junior high and high school levels, the comfort ratings of students were analyzed by the class and period in which they were recorded and where possible, ratings collected from two or more classes during the same school periods were combined to explore whether there was evidence of any effect of "time of day." In all cases, the thermal comfort ratings of the male and female students in every class were analyzed separately. In certain selected classes known to include a considerable number of hypersensitive or atopic individuals, the ratings of the atopic and non-atopic students were analyzed separately. In each school, the teachers' thermal comfort ratings in all periods were combined and analyzed together.

All these analyses took the form of computing a product-moment correlation between the rating scale and either the air temperature or the effective temperature* in the classroom at the end of the particular periods. In those cases where a statistically significant correlation was obtained, we computed the regression equation of temperature on subjective ratings. Using this equation, the temperature was then estimated at which these individuals would be most likely to have rated their thermal sensation #4, "Neither warm nor cool." This temperature is sometimes referred to later as a predicted "neutral" temperature.

In addition, the distribution of the thermal comfort ratings from the teachers and selected groups of students were plotted and inspected. Smoothed frequency curves of the percentages of particular ratings among all ratings recorded per classroom temperature were constructed for the "#4 ratings" (Neither warm nor cool), and for all ratings above 4 and all ratings below 4. The smoothed curves were plotted from the average percentages of ratings per temperature based on data from three adjacent temperatures. The average percentage for each triad of temperatures was plotted against the middle temperature of the triad. The middle temperature of every triad increased successively by one degree Farenheit.

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*The effective temperature scale is a derived index that has been developed to combine in a single scale of values the effects of temperature, humidity and air movement. (See ASHRAE Guide and Data Book, 1967.)

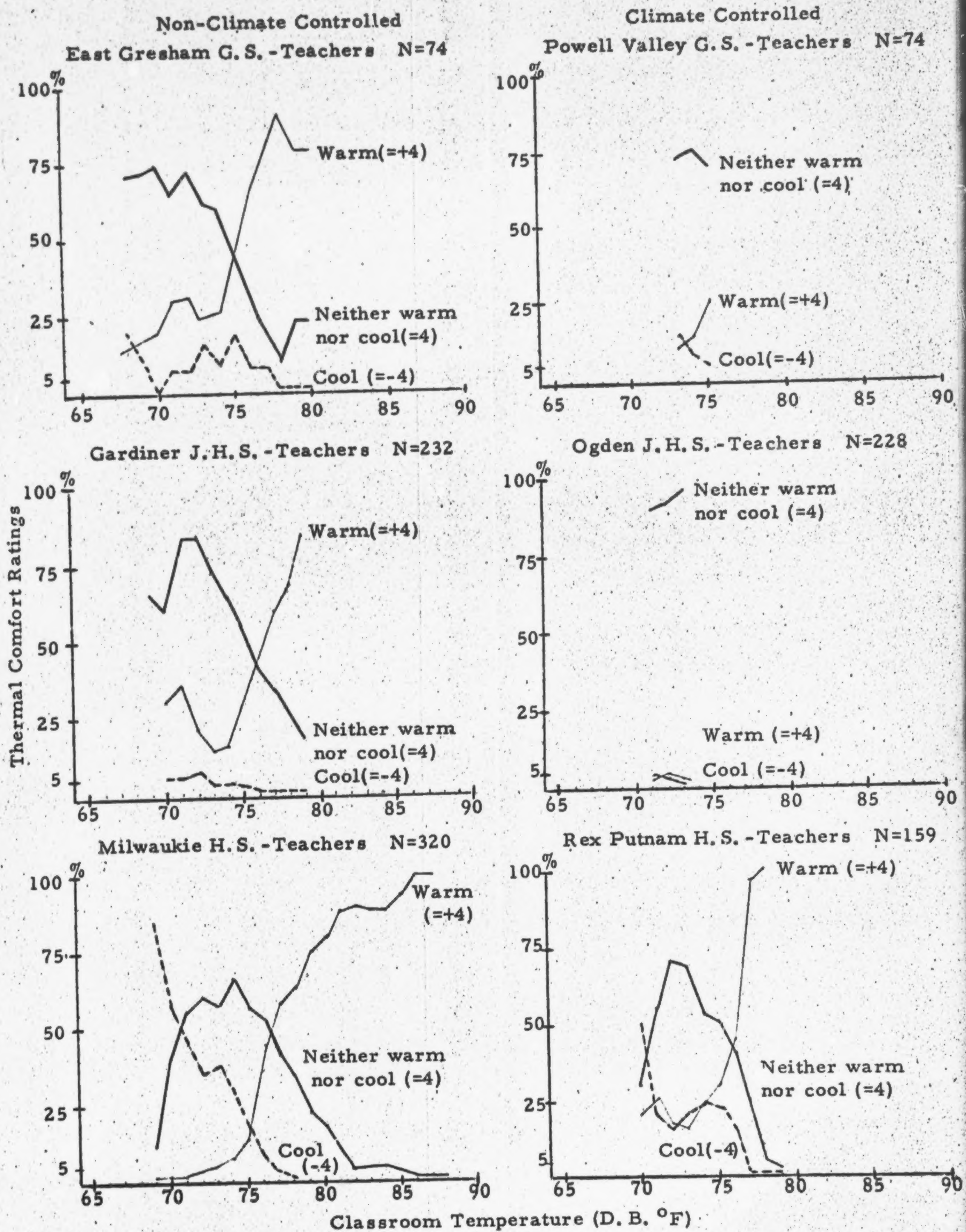
The teachers' ratings of the overall behavior of their classes on a scale of "responsiveness" were analyzed separately for each teacher. This was done because we suspected that teachers would differ in their criteria and reliability in using this highly subjective and difficult to define scale of judgments. Because this was a new scale and we lacked knowledge about the statistical character of these data, we analyzed and tested the relationship between these judgements and classroom temperatures by means of the Chi-Square test. The validity of this test does not depend on the characteristics of the data, and so we could use it to determine whether the number of occasions on which "responsiveness" ratings, given at particular temperatures, were more or less frequent than would have been expected on the basis of pure chance.

## D. Main Findings

### 1. Teachers' Thermal Comfort Ratings

Percentage distributions of the teachers' thermal comfort ratings that were #4 (neutral), above #4 (warm) and below #4 (cool) in each of the non-climate controlled and climate controlled schools in Phases I and II are plotted in Figures 9 and 10, respectively.

Inspection of these charts shows marked differences in ranges of classroom temperatures between the non-climate controlled (65-89°F) and climate controlled schools (69-80°F) and between the two Phases of the study. Also evident are strong contrasts in the distributions of ratings between teachers in the climate controlled and non-climate controlled schools at the grade, junior high and high school levels. The contrast in the distribution of ratings between each pair of schools in Phase I is least marked in the case of the two high schools, on account of the relatively broad range of classroom temperatures that occurred in the climate controlled Rex Putnam High School. In the Fall, during Phase II, the teachers in both the grade and junior high schools tended mostly to rate their thermal sensations as #4 (Neither warm nor cool), whereas in the two high schools, plus 4 (Warm) ratings predominated. The distributions of ratings can be described more specifically in terms of the ranges of temperatures over which more than 50% of the ratings were #4 (Neither warm nor cool), and the temperatures at which the curves for the plus 4(Warm) ratings, and for the minus 4 (Cool) ratings crossed above the #4 curve. The temperatures defining the 50% and above "neutral" zone, and the crossover points at which the "warm" or "cool" ratings predominate are listed in Table I.



Non-Climate Controlled

Climate Controlled

East Gresham G.S. - Teachers N=74

Powell Valley G.S. - Teachers N=74

Gardiner J.H.S. - Teachers N=232

Ogden J.H.S. - Teachers N=228

Milwaukie H.S. - Teachers N=320

Rex Putnam H.S. - Teachers N=159

Figure 9. Percentages of Thermal Comfort Ratings/ Temperature--Phase I

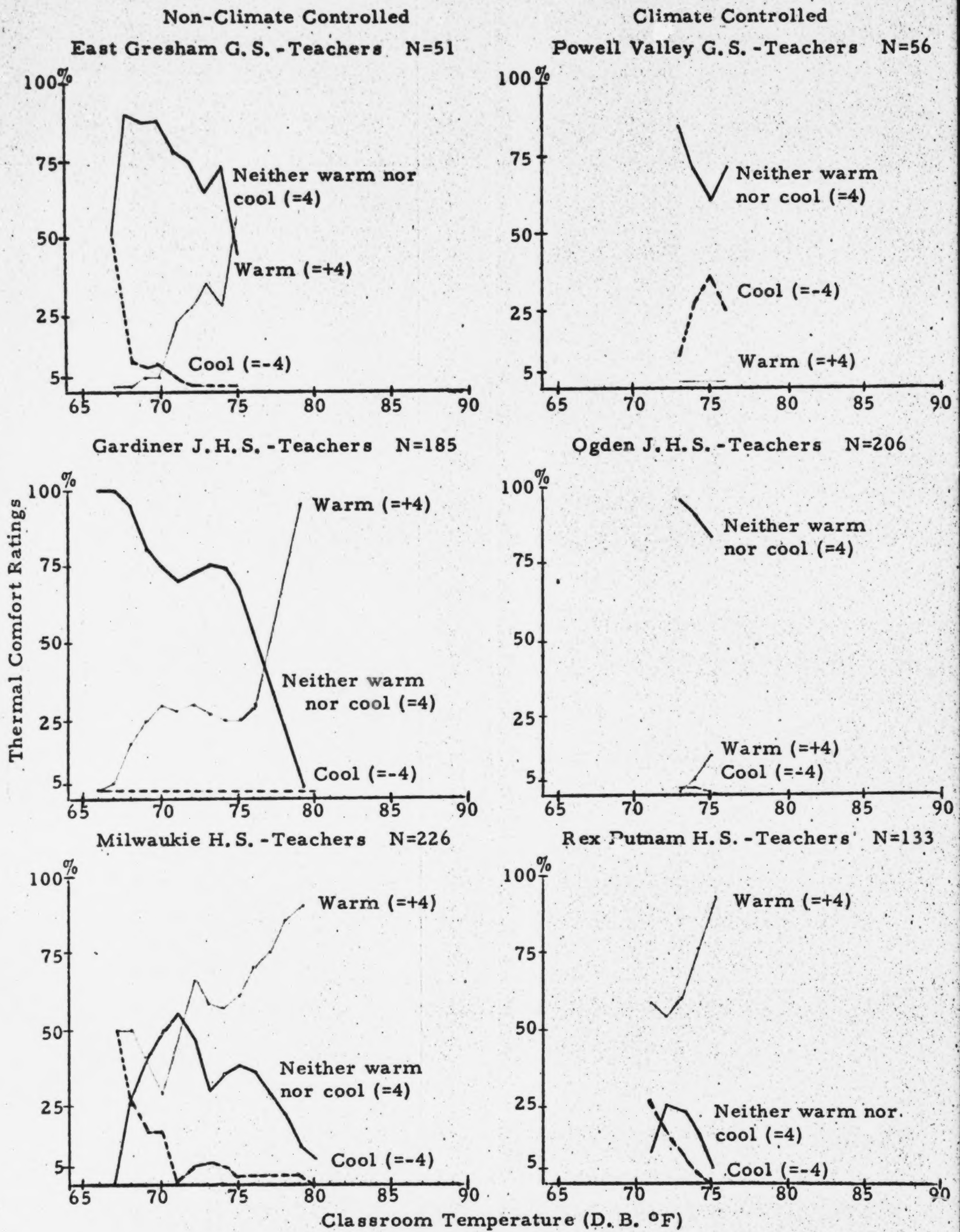


Figure 10. Percentages of Thermal Comfort Ratings/ Temperature--Phase II

## Table I

## Temperature Limits of Frequencies (Percentages) of Teachers' Thermal Comfort Ratings

| School | #4 Ratings > 50% Total °F | -4> 4 Ratings °F | +4 > 4 Ratings °F |
|---|---|---|---|
| Phase I | | | |
| Non-Climate Controlled | | | |
| East Gresham G. S. | (68) - 74.5 | -- | 75 |
| Gardiner J.H.S. | (70) - 76 | -- | 76 |
| Milwaukie H.S. | 70 - 77.5 | 70 | 77 |
| Climate Controlled | | | |
| Powell Valley G.S. | (73.5 - 75.5) | -- | -- |
| Ogden J.H.S. | (71.5 - 73.5) | -- | -- |
| Rex Putnam H.S. | 71 - 75 | 70 | 76 |
| Phase II | | | |
| Non-Climate Controlled | | | |
| East Gresham G.S. | (68) - 75 | -- | 75 |
| Gardiner J.H.S. | (69) - 76.5 | -- | 77 |
| Milwaukie H.S. | 69.5 - 70.5 | 68 | 71 |
| Climate Controlled | | | |
| Powell Valley G.S. | (73 - 76) | -- | -- |
| Ogden J.H.S. | (73.5 - 75.5) | -- | -- |
| Rex Putnam H.S. | -- | 71.5 | 71 |

The teachers in the non-climate controlled grade and junior high schools in both Phases of the study were mostly comfortable over a range of temperatures from about 68-76°F. Teachers in the climate controlled grade and junior high schools were mostly comfortable throughout both Phases since temperatures in these schools varied only 3-4°F within the 71-76°F range of temperatures. In both high schools, classroom temperatures varied in both Phases more than the temperatures in the other schools although the ranges of temperatures in both high schools were reduced in Phase II. During Phase I the zone in which 50% and more ratings were #4 was somewhat broader for the teachers in the non-climate controlled Milwaukie High School than in the climate controlled Rex Putnam High School. In both schools, the percentages of "Cool" ratings predominated at classroom temperatures below 70°F and of "Warm" ratings at temperatures above 76-77°F. In Phase II, the "neutral" zone of temperatures was almost non-existent in the two high schools. The teachers in Milwaukie High School rated their sensations as "Neither warm nor cool" on over 50% instances only at a temperature of 70°F. At higher temperatures, the percentages of "Warm" ratings predominated. In the climate controlled Rex Putnam High School, "Warm" ratings predominated at all temperatures.

The relationships between the teachers' thermal comfort ratings and both the (dry bulb) air temperatures and the effective temperatures of their classrooms in each school in both Phases of the study were determined more exactly by the method of statistical correlation.

The resulting correlation coefficients, the degrees of freedom available for testing statistical significance, the levels of significance and the predicted "neutral" temperatures in the case of the significant correlations are listed in Table II. The predicted "neutral" temperatures are those temperatures (computed from the regression equation of temperature on thermal comfort) which would be most likely when, on the average, the teachers rated their thermal sensations as "Neither warm nor cool." In the non-climate controlled schools in both Phases, the teachers' ratings were correlated significantly with either the classroom air or effective temperatures. This was also true for the Rex Putnam High School which had the greatest range of temperatures (69-80°F) among the climate controlled schools. But in the well-controlled Powell Valley Grade and Ogden Junior High School, where the ranges in temperature were very small (3°F), the teachers' ratings were much less consistently related to classroom temperatures.

Further, the fact that the significant correlations of the teachers' ratings in the climate controlled Powell Valley Grade School were negative in sign was unexpected. This means that there was a statistically reliable tendency for these teachers to report feeling warm at the lower classroom

## Table II

### Correlations of Teachers' Thermal Comfort Ratings with Classroom Temperatures

| | x Dry Bulb Temperature | | | | | x Effective Temperature | | |
|---|---|---|---|---|---|---|---|---|
| School | "r" | df | P< | Predicted #4 Temp. | Temperature Range °F | "r" | P< | Predicted #4 Temp. |
| **Phase I** | | | | | | | | |
| East Gresham | .435 | 70 | .01 | 72.42 | (67-81) | .339 | .01 | 66.33 |
| Gardiner | .406 | 231 | .01 | 74.59 | (69-81) | .393 | .01 | 67.86 |
| Milwaukie | .719 | 319 | .01 | 76.11 | (68-89) | .423 | .01 | 69.11 |
| Powell Valley | -.287 | 70 | .05 | 74.00 | (73-76) | -.317 | .01 | 67.01 |
| Ogden | .096 | 224 | N.S. | - | (71-74) | (95% of Ratings = #4). | | |
| Rex Putnam | .523 | 154 | .01 | 73.92 | (69-80) | .509 | .01 | 67.38 |
| **Phase II** | | | | | | | | |
| East Gresham | .374 | 47 | .01 | 71.57 | (66-76) | .371 | .01 | 66.15 |
| Gardiner | .256 | 181 | .01 | 72.68 | (62-80) | .286 | .01 | 66.09 |
| Milwaukie | .129 | 223 | N.S. | - | (66-80) | .213 | .01 | 67.60 |
| Powell Valley | -.016 | 52 | N.S. | - | (72-77) | .051 | N.S. | - |
| Ogden | .211 | 202 | .01 | 74.50 | (73-76) | .175 | .05 | 68.47 |
| Rex Putnam | .268 | 129 | .01 | 72.63 | (70-76) | .276 | .01 | 66.64 |

temperatures and cool at the higher temperatures. A possible explanation is that because of the frequently higher outside temperatures and the very stable classroom temperatures (73-76°F) in Powell Valley Grade School, the teachers were influenced less by their classroom temperatures than by the contrast with the higher outside temperature. This hypothesis was tested by correlating the teachers' ratings with the differences between classroom air temperature and maximum outside temperature, and between classroom effective temperatures and maximum outside temperature. But in both cases, the new correlation coefficients (-.07 and -.09 respectively) were neither positive nor significant and, therefore, lend no support to this hypothesis.

Correlations were done with both air temperature and effective temperature in order to see whether or not the inclusion of relative humidity with temperature in the effective temperature scale would increase the correlation with thermal comfort ratings. However, 10 of the 12 correlations with effective temperature and 9 of the 12 with air temperature were significant. This suggests that variations in relative humidity from about 20-70% over most of the temperatures encountered in this study had little effect on the teachers' sensations of thermal comfort.

The predicted "neutral" temperatures derived from these correlation and regression analyses show in the non-climate controlled schools a progressive increase with grade level in Phase I (72.42, 74.59 and 76.11°F dry bulb and 66.33, 67.86, and 69.11°F effective temperature) and consistently higher values in Phase I than in Phase II (71.57 and 72.68°F dry bulb and 66.15, 66.09 and 67.60°F effective temperature). These trends are clearly related to the differences in ranges and average temperatures between these schools and between the temperatures in all these schools in Phase I and Phase II. In the climate controlled schools, the predicted "neutral" temperatures were much more alike (74.00, 73.92, 74.50 and 72.63°F dry bulb and 67.01, 67.38, 68.47 and 66.64°F effective temperature) but what differences occurred again reflected the differences in classroom temperatures. It is interesting that the predicted "neutral" temperatures (dry bulb) in all these schools were considerably lower than the temperature of 78°F with a relative humidity of 45% recommended for thermally "neutral" or comfortable conditions by the Kansas State University workers. These differences between the present findings and the K.S.U. data are presumably related to differences in clothing, ranges in temperatures experienced, and possibly activity levels.

### 2. Student Thermal Comfort Ratings

A total of 166 correlations of student thermal comfort ratings with dry bulb temperature and 206 correlations with classroom effective temperature were completed. These correlations are based on totals of approximately

25,000 and 30,000 pairs of ratings of thermal comfort and temperature, respectively. The results of these correlations are listed in Appendix II. The results are also summarized by school and phase of the study in Table III. In the non-climate controlled schools, approximately two-thirds of the correlations with both dry bulb and effective temperature were statistically significant. In Phase I, about 82% and in Phase II, 59% of the correlations in these non-climate controlled schools were significant. This difference in the proportions of significant correlations between Phases I and II is presumably related to the higher temperatures and wider ranges of temperatures that occurred in the non-climate controlled schools in the Spring than in the Fall. In the climate controlled schools, just over one quarter of the correlations with both dry bulb and effective temperatures were significant. Again, the proportion of significant correlations was higher in Phase I (37-42%) than in Phase II (19-22%). However, in the case of the climate controlled schools, this difference in the proportions of significant correlations in Phases I and II appears to be due mainly to the relatively poor temperature control in Rex Putnam High School in the Spring and its improved control in the Fall; and to a lesser extent, to the upward adjustment of temperatures in the well-controlled Ogden Junior High School in the Fall. The students' thermal comfort ratings correlated equally well with both the dry bulb and effective temperature measures of the classroom environments. This shows that over the ranges of temperatures encountered in classrooms in this study the students' thermal comfort sensations were not appreciably influenced by variations in relative humidity from about 20-70%.

The thermal comfort ratings of the students in the three non-climate controlled schools correlate more than twice as often with classroom temperatures than the ratings of the students in the three climate controlled schools. But the temperature controls in the Rex Putnam High School were relatively poor, especially during Phase I, so that if we exclude the data from Rex Putnam in making this comparison of significant correlations, the contrast between the climate controlled and non-climate controlled grade and junior high schools is very much greater, especially for correlations with dry bulb temperature. Presumably, the ranges of air temperatures in these well-controlled schools were too narrow for most of the students to discriminate related variations in their thermal comfort, or to be affected consistently by the differences in temperature. Inspection of Table III also indicates that in these two well-controlled schools (Powell Valley and Ogden) the students' thermal comfort ratings tended to correlate more often with effective temperatures than with the dry bulb air temperature.

In Phase II, significant negative correlations between thermal comfort and effective temperature also occurred in these two well-controlled climate controlled schools--one in Powell Valley Grade School and two in Ogden Junior

## Table III

## Numbers of Correlations of Thermal Comfort Ratings X Classroom Temperature Completed and Significant

| | | Dry Bulb Temperature | | | Effective Temperature | | |
|---|---|---|---|---|---|---|---|
| Schools | Phase | Total | Significant | | Total | Significant | |
| | | N | N | % | N | N | % |
| Non-Climate Controlled | | | | | | | |
| East Gresham | I | 2 | 2 | 100.0 | 2 | 2 | 100.0 |
| Grade | II | 8 | 5 | 62.5 | 8 | 5 | 62.5 |
| Gardiner | I | 18 | 12 | 66.7 | 18 | 11 | 61.1 |
| Junior High | II | 24(4-) | 10 | 41.7 | 24(6-) | 12(1-) | 50.0 |
| Milwaukie | I | 24 | 22 | 91.7 | 24 | 23 | 95.8 |
| High | II | 24(2-) | 18 | 75.0 | 24 | 17 | 70.8 |
| Totals | I | 44 | 36 | 81.8 | 44 | 36 | 81.8 |
| | II | 56 | 33 | 58.9 | 56 | 34 | 60.7 |
| Climate Controlled | | | | | | | |
| Powell Valley | I | 6(3-) | 0 | 0 | 6(2-) | 0 | 0 |
| Grade | II | 8(4-) | 0 | 0 | 8(5-) | 1(-) | 12.5 |
| Ogden | I | 8(3-) | 0 | 0 | 22(8-) | 2 | 9.1 |
| Junior High | II | 16(10-) | 1(-) | 6.25 | 24(18-) | 6(2-) | 25.0 |
| Rex Putnam | I | 10 | 10 | 100.0 | 18 | 15 | 83.3 |
| High | II | 18(3-) | 7 | 38.9 | 28(4-) | 6 | 21.4 |
| Totals | I | 24 | 10 | 41.7 | 46 | 17 | 37.0 |
| | II | 42 | 8 | 19.0 | 60 | 13 | 21.7 |
| Totals | | | | | | | |
| Non-Climate Controlled | | 100 | 69 | 69.0 | 100 | 70 | 70.0 |
| Climate Controlled | | 66 | 18 | 27.3 | 106 | 30 | 28.3 |

High School. Negative correlations also occurred in the other schools during Phase II, but with one exception (Gardiner Junior High School), these cases were not significant (i. e., could have occurred as a result of chance).

Negative correlations between the thermal comfort ratings and classroom temperatures were unexpected. The fact that four of these negative correlations were significant shows that the students in these classes were rating their sensations consistently but contrary to the usual manner. The negative correlations (both significant and non-significant) were most frequent among classes in the climate controlled schools and in Gardiner Junior High School in Oregon City. The fact that during Phase II Oregon City had outside temperatures some 5°F lower than the other two communities, that the climate controlled schools maintained fairly stable inside air temperatures of 74-75°F, and that outside air temperature was decreasing over the period of data collection suggest that the thermal comfort ratings of some students in these schools were affected not so much by the classroom temperatures as by the differences between the inside and lower outside temperatures.

If this interpretation were in fact true, it could mean that the cooler outside air temperatures were lowering the students' subjective standard of a "neutral" or comfortable temperature, and that this effect would be most marked on the coolest days when the classroom temperatures might also tend to be slightly lower. Consequently, on these occasions the classrooms should feel warm whereas on the days when the outside temperature was high (and classroom temperatures were also slightly higher), the classroom should feel relatively cool.

To test this hypothesis, new analyses were made of the comfort ratings of the four groups of students in Powell Valley Grade School and in the two junior high schools who had significant negative correlations with classroom effective temperature. The results are listed in Table IV. The ratings of all four groups of students (at Powell Valley Grade, Ogden and Gardiner Junior High Schools) were found to correlate positively with the differences between inside and outside temperatures. In two cases, significant negative correlations were replaced by significant positive correlations, and in the other two cases, highly significant negative correlations were replaced by almost significant positive correlations. The results of these four new analyses, therefore, tend to support the interpretation that negative correlations between comfort ratings and classroom effective temperatures could have been due to the varying degrees of contrast of classroom temperatures with outside air temperatures.

For every significant correlation obtained between thermal comfort ratings and classroom temperatures, the linear regression equations for

## Table IV

### Correlations of Thermal Comfort Ratings of Selected Groups with (1) Classroom Effective Temperature and (2) Difference in Effective Temperature and Daily Maximum Ambient Temperature

| Group | Corrl. X E. T.<br>r | Corrl. X (E. T. - Max. Amb. T.)<br>r | |
|---|---|---|---|
| Powell Valley Grade School | | | |
| 1 Sixth Grade Class Female Students | -.169* | +.181** | (df = 218) |
| Ogden Junior High School | | | |
| Social Studies Per. 5(R) Female Students | -.155* | +.137* | (df = 200) |
| Social Studies Per. 5(S) Male Students | -.193** | +.114 | (df = 229) |
| Gardiner Junior High School | | | |
| Social Studies Per. 7(A) Male Students | -.244** | +.102 | (df = 160) |

*P<.05
**P<.01

"temperature on comfort" were derived. Using these equations, the temperatures were calculated which on the average would be expected when the individuals in the groups were reporting "Neither warm nor cool" thermal comfort ratings. These equations and the predicted "neutral" temperatures are listed in Appendix III. A summary of the predicted "neutral" temperatures of the male and female students (together with the predicted "neutral" temperatures of their teachers) in each school is presented in Table V. The teachers' predicted "neutral" temperatures were derived from analyses of their comfort ratings in all of their periods of instruction in the three selected classrooms in each school. The most equivalent predicted "neutral" temperatures for the students are therefore the temperatures derived from analyses of the combined classes at grade school level, and the average values from all significant analyses at the junior high and high school levels. In those cases where none of the correlations were significant, the average of the ranges of classroom temperatures was substituted in the table in parentheses as the best estimate available.

It is apparent from Table V that there were no consistent differences between the predicted "neutral" temperatures of the teachers and their students, nor between the male and female students within each school at each Phase of the study. The obvious differences in average predicted "neutral" temperatures are between Phases I and II and among the schools. In the non-climate controlled schools, the "neutral" temperatures in Phase I (72.42-76.77°F) are consistently higher than their counterparts in Phase II (71.16-74.55°F) and in both Phases, the predicted "neutral" temperatures are highest in the high school and lowest in the grade school. In the climate controlled schools, the predicted "neutral" temperatures are very much alike and cluster around a temperature of 74°F. Only the estimated values for Ogden Junior High School in Phase I (72.50°F) were low and reflect the generally lower temperature to which the system was set. The system's target temperature was readjusted upwards (1-2°F) prior to Phase II and the average predicted "neutral" temperatures reflect this change in average classroom conditions.

It is interesting to note that the predicted "neutral" temperatures for students and teachers computed from the regression equations for temperature on their thermal comfort ratings closely reflect the differences in classroom temperatures among the schools and in all cases are on the average about 2-6°F lower than the 78°F dry bulb temperature recommended by the K. S. U. workers for thermally "neutral" conditions.

The predicted "neutral" temperatures of the students in the non-climate controlled junior high and high schools in each Phase of the study also varied between classrooms and between classes in the mornings and afternoons. The students' "neutral" temperatures and the ranges in classroom

## Table V

## Average Predicted "Neutral" Temperatures

| School | Dry Bulb (°F) | | Effective Temperature (°F) | |
|---|---|---|---|---|
| | Phase I | Phase II | Phase I | Phase II |
| Non-Climate Controlled | | | | |
| East Gresham G. S. | | | | |
| Teachers | 72.42 | 71.57 | 66.33 | 66.15 |
| Males | 72.53 | 71.16 | 66.34 | 65.81 |
| Females | 72.48 | 71.20 | 66.35 | 65.88 |
| Gardiner J. H. S. | | | | |
| Teachers | 74.59 | 72.68 | 67.86 | 66.09 |
| Males | 74.33 | 72.57 | 69.01 | 66.24 |
| Females | 74.12 | 72.02 | 68.87 | 65.83 |
| Milwaukie H. S. | | | | |
| Teachers | 76.11 | (73.60) | 69.11 | 67.60 |
| Males | 76.22 | 74.55 | 69.90 | 67.39 |
| Females | 76.77 | 74.24 | 69.23 | 67.27 |
| Climate Controlled | | | | |
| Powell Valley G. S. | | | | |
| Teachers | 74.00 | (74.50) | 67.01 | (68.00) |
| Males | (74.33) | (75.00) | (67.33) | (68.25) |
| Females | (74.33) | (75.00) | (67.33) | (68.25) |
| Ogden J. H. S. | | | | |
| Teachers | (72.50) | 74.50 | (66.00) | 68.47 |
| Males | (72.50) | 74.82 | 66.94 | 68.69 |
| Females | (72.50) | (74.67) | (66.00) | 68.67 |
| Rex Putnam H. S. | | | | |
| Teachers | 73.92 | 72.63 | 67.38 | 66.64 |
| Males | 73.37 | 73.54 | 67.41 | (67.54) |
| Females | 73.57 | 73.25 | 67.59 | 67.35 |

temperatures in these two schools are listed in Table VI for combined data from all classes in specified periods in some cases and for selected classes in others both early and late in the school day. The differences in "neutral" temperatures within each school are clearly related to the different ranges of room temperatures experienced by the classes at the specified periods during Phases I and II.

There is no evidence from Table VI of any marked difference in "neutral" temperatures related to the sex of the students. However, there was evidence in the two high schools in Phase I of a slight but consistent difference in predicted "neutral" temperatures between the sexes. Also, in the generally cooler conditions of Phase II, the ratings of female students in the two high schools tended to be more highly correlated with classroom temperatures than those of male students. Reference to Table VII shows that in Phase I in Milwaukie High School in four out of five separate classes in which the ratings of both males and females were significantly correlated with effective temperature the predicted "neutral" temperatures for the females were slightly higher than those for the males. In Rex Putnam High School over the same period a similar difference occurred in all five classes in which the correlations for male and female students were both significant. As can be seen from Table VII, the differences in each instance are very small, but in these two schools in nine of the ten cases correlated with effective temperature and seven of eight cases with dry bulb temperature the differences were all in the same direction. Reference to Appendix II will show that in Phase II the correlations of the students' thermal comfort ratings with effective temperature in Rex Putnam High School were significant only in the case of female students. In Milwaukie High School in Phase II, the correlations of the thermal comfort ratings of the female students with effective temperature in the analyses of combined data from all periods 1, 4 and 7 were consistently more significant than for the male students. These latter results are based on analyses of almost 2,800 pairs of data, and mean that the female students' comfort ratings in Milwaukie High School were associated more closely with classroom temperatures than the ratings of the male students.

Both of these findings are in line with the observation of the K.S.U. workers that there was only a small difference between the "neutral" temperatures of male and female college students, but that female students were more sensitive to minor changes in temperature.

Some qualitative effects of differences in sex, time of day and season of the year on the patterns of the students' thermal comfort ratings can be seen from the percentage distributions of student ratings against temperature derived from the ratings of students in Milwaukie High School and plotted in Figures 11 and 12. The distributions of ratings for male and

## Table VI

### Predicted "Neutral" Temperatures and Ranges of Actual Temperatures per Period

| | Phase I | | | Phase II | | | |
|---|---|---|---|---|---|---|---|
| School/ Class | Sex | #4 Temp. °F | Actual Range °F | Class | Sex | #4 Temp. °F | Actual Range °F |
| Gardiner J.H.S. | | | | | | | |
| Per. 1 (Comb.) | F | 73.16 | (69-77) | Per. 1 | F | 70.75 | (62-74) |
| | M | 73.12 | (69-77) | (Soc. St.) | M | 70.70 | (62-74) |
| Per. 7 (Soc. St.) | F | 76.09 | (74-81) | Per. 2 | F | 71.47 | (68-74) |
| | M | 76.32 | (74-81) | (Soc. St.) | M | --- | (68-74) |
| | | | | Per. 3 | F | 73.85 | (68-80) |
| | | | | (Spanish) | M | 74.44 | (68-80) |
| Milwaukie H.S. | | | | | | | |
| Per. 1 (Comb.) | F | 75.84 | (68-85) | Per. 1 | F | 70.90 | (66-73) |
| | M | 75.37 | (68-85) | (Latin) | M | 70.79 | (66-73) |
| Per. 5 (Comb.) | F | 78.17 | (72-86) | Per. 1 | F | 74.59 | (72-78) |
| | M | 77.68 | (72-86) | (Math) | M | 74.75 | (72-78) |
| | | | | Per. 7 | F | 75.39 | (71-80) |
| | | | | (Math) | M | 75.67 | (71-80) |
| | | | | Per. 7 | F | 75.73 | (72-79) |
| | | | | (Geom.) | M | 76.76 | (72-79) |

## Table VII.

## Predicted "Neutral" Temperatures for Male and Female Students in High Schools--Phase I

| Class/Period | Effective Temperature | | | | Dry Bulb Temperature | | |
|---|---|---|---|---|---|---|---|
| | M | F | Diff. | | M | F | Diff. |
| Milwaukie H. S. | | | | | | | |
| Geometry/1 | 68.57 | 68.56 | -0.01 | | 75.33 | 75.43 | 0.10 |
| Latin III/1 | 66.13 | 66.19 | 0.06 | | 72.72 | 72.97 | 0.25 |
| Geometry/5 | 70.53 | 70.55 | 0.02 | | 78.40 | 78.34 | -0.06 |
| Gen. Math/5 | 69.44 | 70.55 | 1.11 | | 77.60 | 79.15 | 1.55 |
| Latin I/5 | 69.12 | 69.76 | 0.64 | | 76.45 | 77.50 | 1.05 |
| Rex Putnam H.S. | | | | | | | |
| Gen. Math/1 | 65.80 | 65.92 | 0.12 | | 71.93 | 72.01 | 0.08 |
| Latin/1 | 67.15 | 67.28 | 0.13 | | 73.98 | 74.12 | 0.14 |
| Geometry/6 | 67.54 | 67.95 | 0.41 | | 74.20 | 74.60 | 0.40 |
| Geometry/7 | 68.19 | 68.20 | 0.01 | | --- | --- | --- |
| Geometry/9 | 68.39 | 68.43 | 0.04 | | --- | --- | --- |

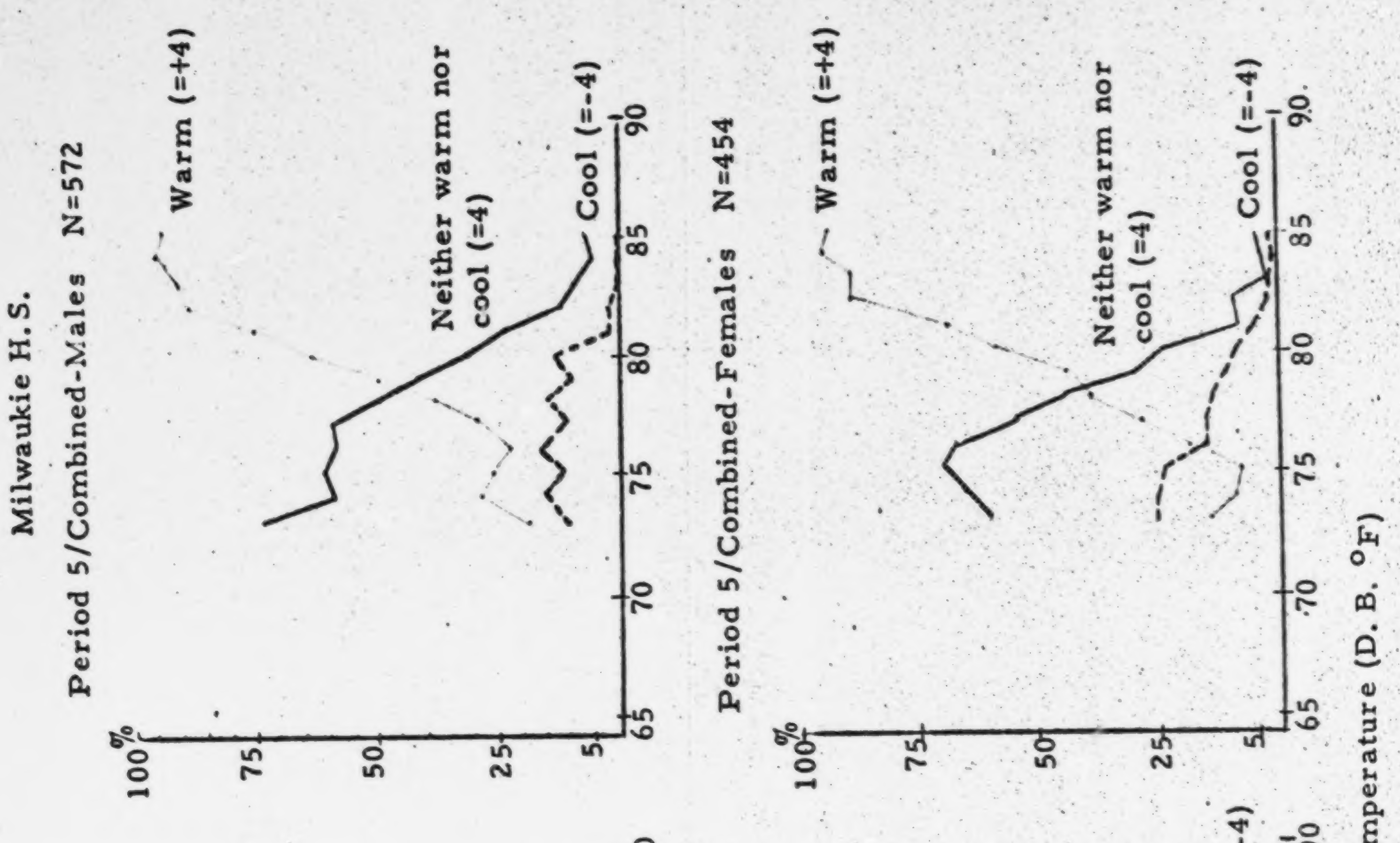
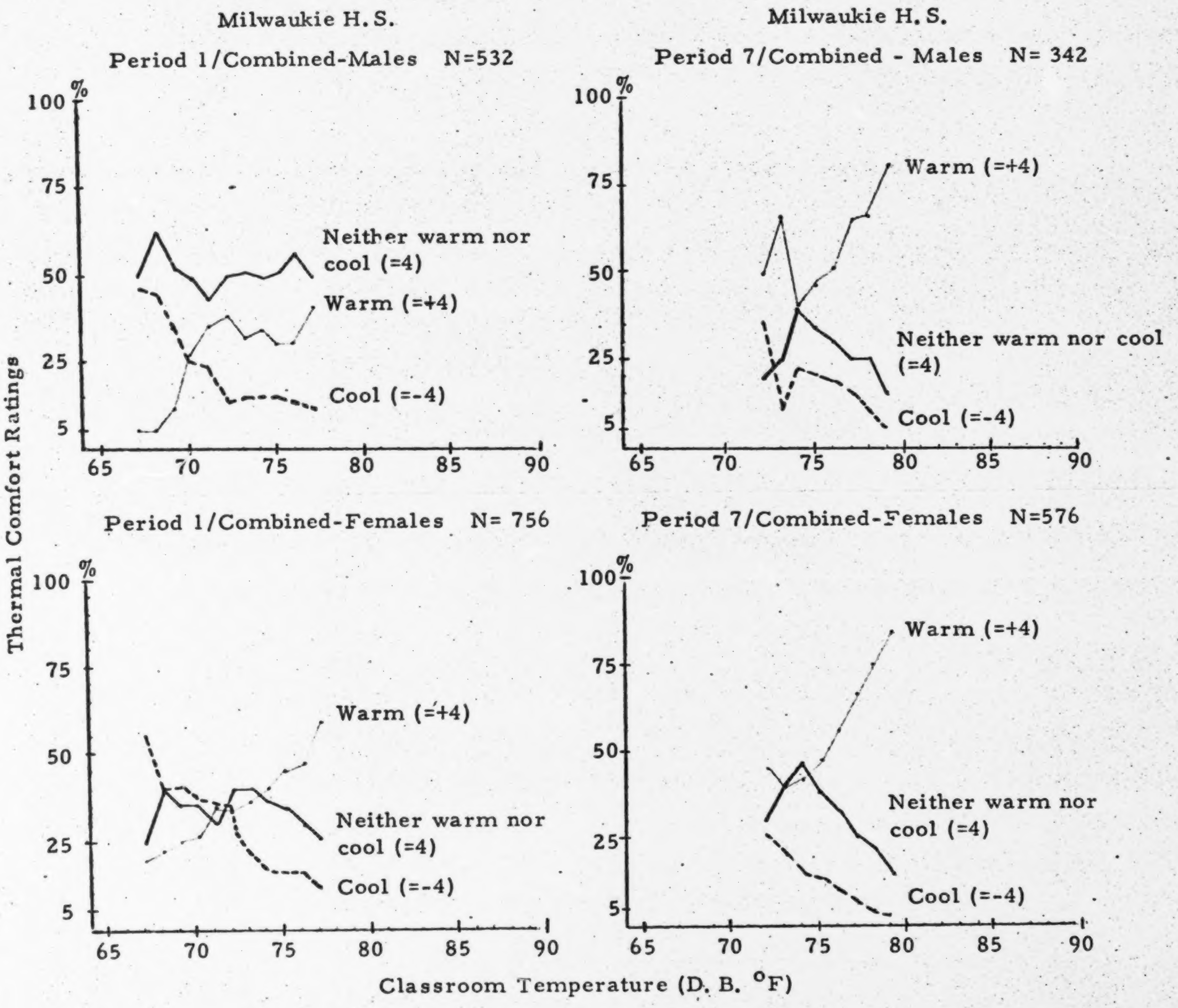


Figure 11 . Percentages of Thermal Comfort Ratings/ Temperature--Phase I


Milwaukie H.S.

Period 1/Combined-Males N=532

Milwaukie H.S.

Period 7/Combined - Males N= 342

Period 1/Combined-Females N= 756

Period 7/Combined-Females N=576

Figure 12. Percentages of Thermal Comfort Ratings/ Temperature--Phase II

female students at each period and phase are based on between 350-750 individual ratings. The distributions are plotted as smoothed curves in which each point is the average percentage of ratings over three adjacent temperatures. Inspection of either the Phase I data in Figure 11, or Phase II data in Figure 12 reveals consistent changes in the pattern of ratings from period one in the morning to periods five or seven in the afternoon. In the mornings when the temperatures are somewhat lower, the proportions of #4 (Neither warm nor cool) ratings average between about 40-60% over most of the ranges of temperatures and only at the extremes of the ranges do the plus and minus #4 ratings predominate in frequency. In the afternoons with a slightly higher range of temperatures and for both Phases and for both males and females, the pattern of ratings is quite different. The range of temperatures over which a large portion of the #4 ratings predominate is narrower in the afternoons than in the mornings. The students appear to discriminate more clearly between the temperatures at which they are "Neither warm nor cool" and temperatures when they are feeling "Slightly warm" or "Warm."

This difference between the distributions of ratings in the mornings and afternoons cannot be attributed simply to the slightly higher temperatures in the afternoons, since a difference in the proportions of the three categories occurs even over temperatures that are the same in the morning and afternoons. It appears as if the students feel comfortable at higher classroom temperatures in the mornings than in the afternoons.

The sex of the students appears to influence the distributions of thermal comfort ratings given early in the morning, but not those given later in the afternoon. In the mornings (and especially during Phase II), female students appear to have been more ready than male students to give either "Cool" or "Warm" ratings.

The time of year in which the ratings were collected appears to have little effect on the distribution of ratings in the mornings, but a marked effect on those given in the afternoons.

Despite the generally narrower ranges of classroom temperatures in Phase II than Phase I, the high school students in the Fall gave proportionately far fewer #4 ratings and a consistently higher proportion of "Warm" ratings throughout the range of temperatures. A similar change in the pattern of teachers' ratings between Spring and Fall was also noted in both high schools. It would seem that the students (and teachers) at the high school level are especially affected in the afternoons by the lower outside temperatures which occurred in the Fall. The more frequent "Warm" ratings might therefore be due to the subjective contrast between the inside and outside temperatures. Since this marked tendency of the students to give "Warm" ratings in the afternoons in the Fall occurred only at the high school level, one wonders what special factors at the high school level could contribute to this effect. For example, did the students (and teachers) at the high schools, more than in the other schools, dress in the Fall in accordance with the dictates of fashion rather than with regard to the season and weather?

An additional factor that the study was designed to investigate concerned a possible differential response of atopic (hypersensitive or allergic) students to differences in classroom thermal conditions. The students in classes that were providing thermal comfort data had been classified previously by the school nurse as either atopic or non-atopic (see Appendix I, Instructions to School Nurses). For the purposes of this analysis, rating data from classes with relatively high percentages of atopic students (20-50%) were selected and separate correlations computed for the atopic and non-atopic students. The results of the analyses of the thermal comfort ratings of atopic and non-atopic students in relation to the classroom effective and dry bulb temperatures are listed in Appendix II.

The results of the analyses of the ratings of atopic and non-atopic students in all schools in both Phases appear somewhat contradictory and inconclusive. However, any differential effect of classroom temperature on the thermal comfort of atopic students might be more likely among the younger students in grade and junior high schools, and during the Spring when both tree and grass pollens prevalent in the air at that time might be affecting some of the students identified as atopic. Unfortunately, the data from East Gresham Grade School on the numbers of atopic students was incomplete, but the results of the analyses of data from three sixth grade classes in Powell Valley Grade School and four classes in both Gardiner and Ogden Junior High Schools in Phase I are summarized in Table VIII. In neither of the climate controlled schools did the students' thermal comfort ratings in these classes correlate with the dry bulb temperature. But, in Ogden Junior High School, the ratings of the atopic students in one class correlated significantly with effective temperature. Also, in two of the classes in the non-climate controlled Gardiner Junior High School, the dry bulb temperatures correlated only with the ratings of the atopic students; and in one other class, the coefficients of correlation with dry bulb and effective temperature were higher for the atopic than for the non-atopic students.

These limited analyses of the rating data of atopic and non-atopic students suggest that in the Spring the atopic students at the junior high school level were more sensitive than the non-atopic students to differences in classroom temperatures. The analyses of the ratings of the high school students in Phase I and of students from all schools in the Fall give no evidence of any differential sensitivity of the atopic students.

# Table VIII

## Correlations of Thermal Comfort Ratings of Atopic and Non-Atopic Students with Classroom Temperature (D. B.)--Phase I; Non-Climate Controlled Schools

| School/Class | Atopic, Non-Atopic Students | Correlation Coefficient r | df | P< | Predicted #4 Temp. °F | Actual Range °F |
|---|---|---|---|---|---|---|
| Gardiner J. H. S. | | | | | | |
| Social/1 (B) | A | .402 | 314 | .01 | 73.17 | (70-76) |
| | NA | .085 | 392 | NS | --- | (70-76) |
| Spanish/1 | A | .105 | 403 | .05 | 73.70 | (69-79) |
| | NA | .147 | 150 | NS | --- | (69-79) |
| Spanish/3 | A | .316 | 338 | .01 | 76.07 | (72-79) |
| | NA | .180 | 269 | .01 | 76.37 | (72-79) |
| Social/7 (A) | A | .427 | 132 | .01 | 76.86 | (74-81) |
| | NA | .415 | 297 | .01 | 76.97 | (74-81) |
| Milwaukie H. S. | | | | | | |
| Geometry/1 | A | .281 | 343 | .01 | 75.41 | (69-81) |
| | NA | .236 | 256 | .01 | 75.38 | (69-81) |
| Latin III/1 | A | .566 | 83 | .01 | 72.90 | (68-76) |
| | NA | .527 | 109 | .01 | 72.67 | (68-76) |
| Geometry/5 | A | .654 | 247 | .01 | 78.45 | (75-86) |
| | NA | .715 | 325 | .01 | 78.28 | (75-86) |
| Latin I/5 | A | .634 | 136 | .01 | 76.97 | (72-85) |
| | NA | .581 | 131 | .01 | 76.81 | (72-85) |

### 3. Teachers' Class Behavior Ratings

Teachers' ratings of the "responsiveness" of their classes were tabulated for each teacher and the frequencies with which different ratings were given at temperatures below and above a particular effective temperature were counted. The frequencies of ratings were counted separately for effective temperatures above and below an approximate median temperature, usually about 68°F (effective temperature). The ratings were also grouped into two or three value categories to produce a 2x2 and 2x3 way table in which at least five ratings might be expected to fall by chance in any cell of the table. The numbers of ratings which in fact fell into each cell of these frequency tables are shown in Appendix IV for those instances where the distribution was significantly different from a purely chance distribution. The level of significance was tested by the use of Chi-Square and the values obtained are also given. The results of these separate analyses are summarized in Table IX. In Phase I the class behavior ratings of six of nine teachers in the non-climate controlled and only one of nine in the climate controlled schools were significantly related to the effective temperature in the classrooms. In Phase II, the class behavior ratings of four of the nine teachers in the non-climate controlled and one of the nine in the climate controlled schools were significantly related to effective temperature. In all cases in Phase I and three cases in the non-climate controlled schools in Phase II, the teachers rated their classes as showing a more than average level of responsiveness in periods with the lower effective temperatures. But one teacher at Milwaukie High School and one at Ogden Junior High School in Phase II showed an opposite relationship between their ratings and temperature; i.e., they more frequently rated their class (Geometry and Social Studies, respectively) as above average in responsiveness in periods with higher effective temperatures.

Other than noting that there were these statistically significant relationships between classroom effective temperature and the class behavior ratings of some of the teachers, especially in the non-climate controlled schools, little more can be said. The absence of any such relationship for the ratings of the other teachers could be due to the fact that the behavior of the students in their classes was unaffected by temperature, to the fact that these teachers did not perceive any such changes or because these teachers failed to use the rating scale in a way that reflected any such changes in responsiveness.

In the case of teachers whose ratings were related significantly to temperature, we do not know, of course, whether the temperature variations were in fact affecting the class behavior, the teachers' own perceptions and/or their use of the scale, or all of these together.

## Table IX

### Frequencies of Significant Associations Between Teachers' Class Behavior Ratings and Temperature (E. T.)

| | Phase I | Phase II |
|---|---|---|
| Non-Climate Controlled | | |
| East Gresham G. S. | 1:3 | 0:3 |
| Gardiner J. H. S. | 3:3 | 1:3 |
| Milwaukie H. S. | 2:3 | 3:3 (1+) |
| | 6:9 | 4:9 |
| Climate Controlled | | |
| Powell Valley G. S. | 0:3 | 0:3 |
| Ogden J. H. S. | 0:3 | 1:3 (+) |
| Rex Putnam H. S. | 1:3 | 0:3 |
| | 1:9 | 1:9 |

## IV. TEST PERFORMANCE MEASURES

### A. Introduction

The great majority of schools in most parts of the country are still not air-conditioned. School boards and the general public for the most part seem unconvinced that overheated classrooms reduce the efficiency of the educational process. The reluctance of communities to provide funds for building air-conditioned schools suggests that any possible adverse effects of heat are regarded as probably small and easily compensated for by some increase in effort from teachers and students. One wonders to what extent this negative attitude of the public toward air-conditioned schools can be summed up by the comment, "We didn't have air-conditioned schools in our day, and we did alright," or, "Kids nowadays are spoiled enough already without giving them air conditioning." On the other hand, a survey of the attitudes of the teachers in the six schools participating in this study showed that an overwhelming majority recognized a need for air conditioning in schools (Fabrizio and Pepler, 1970). Over 90% of the teachers agreed that comfort and over 75% that performance and behavior of their students were enhanced by air conditioning. Some objective evidence is now available of the beneficial effect of a climate controlled classroom environment on student learning and on the performance of both academic achievement tests and other tests of mental abilities necessary for achievement in school work. In a three-week experiment conducted in a special laboratory type school consisting of two classrooms, fourth grade pupils in a climate controlled classroom learned a number of elementary clerical, arithmetic and conceptualizing skills significantly better than a matched group of pupils in a parallel non-climate controlled room (Peccolo, 1962). Results of a study in a climate controlled and two non-climate controlled schools in Pinellas County, Florida, demonstrated that improvements in achievement scores over the academic year were greatest for students in the climate controlled school (Stuart and Curtis, 1964). However, an interpretation of these latter findings as simply an effect of classroom temperature is questionable, since the schools differed also in quality of staff and in pupil ability and backgrounds.

In a laboratory study, college students of both sexes studied a programmed text less efficiently during three hour exposures once per week to temperatures 6-12°F above and below a temperature of 80°F (Pepler and Warner, 1968). The way in which students studied the text and the levels of effort reported changed in the higher and lower temperatures.

Swedish workers have reported that in four different experiments indoor temperatures of 80-86°F had a detrimental influence on certain mental achievement tests which play an important role in school work (Lofstedt, Ryd, and Wyon, 1969). These authors comment that the influence of temperature is more disadvantageous for children working near the limit of their mental capacity. A similar comment has been made about the effects of high temperatures on the mental and physical performances of young servicemen (Mackworth, 1950).

Our objective in collecting measures of student achievement in selected courses in each of the six schools participating in the present study was to obtain reliable evidence of any influence of naturally occurring variations in classroom temperature on the level of students' work in both climate controlled and non-climate controlled schools at different grade levels.

We had hoped to obtain measures of the students' learning performances as they studied programmed texts, but this was not possible. Instead, we arranged for students in selected courses to be tested two times per week throughout each of two nine-week marking periods. In this way, we hoped to obtain enough measures of test performance at different classroom temperatures to enable us to test the statistical significance of any apparent association of academic performance with classroom temperature.

## B. Data Collection Procedures

A score (on a scale of 0-100) was obtained two times a week on written tests of knowledge of course material for each student in selected classes at every school. At the grade school level, a course in Spelling for sixth grade students was selected. It is a course of instruction in which periodic vocabulary spelling tests are normally given and which are designed to assess the children's progress from week to week. Both participating grade schools arranged to give their sixth grade students spelling tests two times per week and the teachers agreed to score the children's performances on a percentage type scale. In each school, the spelling tests were always given at the same time of day, and at the approximate time when the children (and the teachers) also give their ratings of thermal comfort and the teacher rated the level of class "responsiveness."

At the junior high school level, a seventh grade Social Studies course taught by two teachers in each school, and Spanish language courses for eighth and ninth grade students taught by the same teacher in both schools were selected for study. The Spanish language course again provided an opportunity to test learning of course materials by means of vocabulary tests that could be conveniently scored on a percent type scale. The four Social Studies teachers in the two junior high schools knew about the requirements of this study for measuring performance on objective tests and they designed their course to meet our requirements. The schools felt that this course was sufficiently structured and factual in character to permit the development of valid tests of learned material that could be reliably scored on a percentage scale and be administered two times a week.

At the high school level, the problem of selecting courses in which learning could be repeatedly and reliably tested was more difficult. The final selection, following repeated discussions with the principals and teachers in both schools was Latin (10, 11, 12th grade), General Math (10, 11th grade) and Geometry (11, 12th grade). The selection of particular classes and teachers for the study in the high schools was influenced to a large degree by the location of their classrooms in the southern wing of the non-climate controlled Milwaukie High School; equivalent classes were selected in Rex Putnam High School. It was the opinion of the principals and teachers that these courses could reasonably accommodate two tests per week and that the tests would be comparable week by week and could be reliably scored.

## C. Method of Analysis

Detailed analyses were performed on data again collected during May and a one-month period from September 22 to October 17.

The method used for determining any possible relationship between classroom temperatures and performance on the tests was to correlate individual measures of test performance with the classroom temperatures when the tests were being taken. To remove some of the uncontrolled variability in raw scores due to differences between students and between tests, the measures of test performance used were the algebraic deviations of individuals' test scores from their own individual mean scores for the one-month period. At the grade school level, the results of the spelling tests in the three sixth grade classes were analyzed separately and in combination. At the junior high and high school levels, the results of the tests of each class of students taking one of the designated courses were analyzed separately, in combination by course and in combination by instructional period across courses. In this way, it was hoped to isolate any possible differential effects of the classroom temperatures within separate classes and as a function of course material and also of "time of day."

As in the case of the thermal comfort rating analyses, we first correlated the deviations in individual test scores with the effective temperature in the classroom at the end of the periods in which the tests were taken. But a smaller number of correlations were also performed between deviations in test scores and dry bulb air temperature.

Correlations were also performed between the individuals' deviations in their test scores and the rating of thermal comfort at the ends of the periods in which they had taken the tests.

## D. Main Findings

The results of 65 separate analyses of students' test scores with effective temperature and 35 analyses with dry bulb air temperature for individual classes and periods as well as the results of another 33 analyses of the combined data for several classes or periods with effective temperature and 18 with dry bulb temperature are tabulated in Appendix V.

Our principal interest in the analyses of test performance measure at different temperatures is to see whether performance on all tests or only tests in certain academic subjects are affected by classroom temperature, whether students on the average do equally well at the same classroom temperature in all the courses, or whether the students in different courses, at different grade levels, or in different schools produce their normal levels of work at different temperatures.

Evidence of any overall effects of temperature on performance in each particular course or subject is best obtained from analyses of combined data from several classes of students taking each course at different times and with different teachers. The results of such analyses of combined data for tests in each of the six different courses in the three non-climate controlled and three climate controlled schools in Phase I and Phase II are given in Tables X and XI for correlations with classroom effective and air (dry bulb) temperatures, respectively.

Both tables provide clear evidence that classroom temperatures did affect the academic performance of students in schools at all three grade levels. They also show, quite unexpectedly, that the variations in classroom temperature affected student performance in the climate controlled schools as well as in the non-climate controlled schools. For the non-climate controlled schools, evidence of statistically significant correlations between student performance and classroom temperature is generally similar in both tables. Most of the significant correlations occurred with data from Phase I, when classroom temperatures were generally higher and varied over greater ranges than in Phase II. In every case in the non-climate controlled schools, the correlations were negative in sign; i.e., the students performed less well at the higher temperatures.

The results of the analyses of data from the non-climate controlled schools are generally what had been expected. When classroom temperatures were

## Table X

## Results of Analyses of Test Performance Scores and Classroom Effective Temperatures

| School/Class | Phase I | | | | Phase II | | | |
|---|---|---|---|---|---|---|---|---|
| | "r" | df | P< | Mean Score Temp. (°F) | "r" | df | P< | Mean Score Temp. (°F) |
| Non-Climate Controlled | | | | | | | | |
| East Gresham G. S. | | | | | | | | |
| Spelling | -.195 | 649 | .01 | 67.36 | .066 | 448 | NS | --- |
| Gardiner J. H. S. | | | | | | | | |
| Spanish | -.109 | 497 | .05 | 68.96 | -.200 | 210 | .01 | 68.60 |
| Social Studies | -.154 | 498 | .01 | 69.36 | -.033 | 595 | NS | --- |
| Milwaukie H. S. | | | | | | | | |
| Latin | -.145 | 399 | .01 | 68.72 | -.065 | 224 | NS | --- |
| Geometry | -.195 | 457 | .01 | 70.46 | .033 | 739 | NS | --- |
| General Math | -.055 | 428 | NS | --- | .034 | 412 | NS | --- |
| Climate Controlled | | | | | | | | |
| Powell Valley G. S. | | | | | | | | |
| Spelling | .126 | 546 | .01 | 67.13 | .031 | 559 | NS | --- |
| Ogden J. H. S. | | | | | | | | |
| Spanish | -.141 | 435 | .01 | 66.88 | -.015 | 304 | NS | --- |
| Social Studies | -.313 | 449 | .01 | 66.72 | .024 | 513 | NS | --- |
| Rex Putnam H. S. | | | | | | | | |
| Latin | .009 | 274 | NS | --- | -.215 | 373 | .01 | 66.11 |
| Geometry | -.104 | 419 | .05 | 68.05 | .448 | 412 | .01 | 67.67 |
| General Math | .088 | 619 | .05 | 66.45 | -.009 | 328 | NS | --- |

## Table XI

### Results of Analyses of Test Performance Scores and Classroom Dry Bulb Air Temperatures

| | Phase I | | | | Phase II | | | |
|---|---|---|---|---|---|---|---|---|
| School/Class | "r" | df | P< | Mean Score Temp. ($^{o}$F) | "r" | df | P< | Mean Score Temp. ($^{o}$F) |
| Non-Climate Controlled | | | | | | | | |
| East Gresham G. S. | | | | | | | | |
| Spelling | -.171 | 649 | .01 | 73.86 | .035 | 448 | NS | --- |
| Gardiner J. H. S. | | | | | | | | |
| Spanish | -.117 | 497 | .01 | 75.66 | -.083 | 205 | NS | --- |
| Social Studies | -.004 | 498 | NS | --- | -.029 | 877 | NS | --- |
| Milwaukie H. S. | | | | | | | | |
| Latin | -.105 | 399 | .05 | 76.42 | -.006 | 370 | NS | --- |
| Geometry | -.230 | 457 | .01 | 78.17 | -.054 | 1158 | NS | --- |
| General Math | -.064 | 428 | NS | --- | .027 | 882 | NS | --- |
| Climate Controlled | | | | | | | | |
| Powell Valley G. S. | | | | | | | | |
| Spelling | .090 | 546 | .05 | 74.02 | .111 | 553 | .01 | 74.57 |
| Ogden J. H. S. | | | | | | | | |
| Spanish | -.025 | 435 | NS | --- | -.151 | 307 | .01 | 74.30 |
| Social Studies | -.183 | 449 | .01 | 72.66 | .121 | 1120 | .01 | 74.65 |
| Rex Putnam H. S. | | | | | | | | |
| Latin | .308 | 274 | .01 | 75.04 | -.177 | 373 | .01 | 71.95 |
| Geometry | .049 | 419 | NS | --- | .345 | 412 | .01 | 73.85 |
| General Math | .046 | 619 | NS | --- | .252 | 328 | .01 | 73.09 |

high and varied over a wide range in the Spring, the students at all grade levels tended to work less well at the higher temperature. In the Fall, when the variations in classroom temperatures were much smaller and average temperatures somewhat lower, the students' academic performances were mostly unaffected by variations in classroom temperature.

Evidence from the climate controlled schools that even small variations in temperature affected academic performance was unexpected. These results are much more variable and difficult to understand. In Phase I, the students' performance measures correlated significantly with effective temperature for five of the six courses, and with dry bulb temperature for three of the six courses. However, for each set of these significant correlations, two of the correlation coefficients were positive in sign, i. e., students did better at the higher temperatures. In Phase II, in the climate controlled schools, the students' performances in every course correlated significantly with classroom dry bulb temperature, but with effective temperature, only in two courses in Rex Putnam High School. Also, in four courses the correlations with dry bulb temperature were positive, as was one of the two correlations with effective temperature.

The unexpected results of these correlation analyses on data from the climate controlled schools raise a number of questions, which cannot be answered with certainty. Firstly, why did we get significant correlations in the climate controlled schools of academic performance with classroom temperatures that varied only 2 or 3°F, when in some instances in the non-climate controlled schools there were no correlations of performance with classroom temperatures that varied over 8 or 10°F? A probable reason for this finding is suggested by evidence from other studies (see Leithead and Lind, 1964). People become accustomed and their bodies adjusted not only to a particular temperature level, but also to the range of temperature variation to which they are habitually exposed. We have found already in this study that the students in the non-climate controlled schools gave predominantly "neutral" thermal comfort ratings over a wider range of temperature than students in the climate controlled schools. The students in the climate controlled schools apparently discriminated much smaller variations in temperature as "cool" or "warm" than the students in the non-climate controlled schools. If we assume that an analogous process affects the stability of performance under varying conditions, we should postulate that the academic performances of students in the non-climate controlled schools would be less adversely affected by small variations in classroom temperature than students in the climate controlled schools--as was in fact the case in Phase II.

A second question posed by the results in the climate controlled schools is why were some of the correlations positive in sign? That is to say, why did the students in some courses and classrooms in the climate controlled schools work better in the higher temperatures than in the lower temperatures that occurred even in the very well controlled classrooms, such as in Powell Valley Grade and Ogden Junior High School? Since two out of the three significant correlations with dry bulb temperature in Phase I and four out of the six correlations in Phase II were positive, it appears that the test performances of students in the climate controlled schools were more vulnerable to small differences in classroom temperature in the Fall, when outside temperatures were generally low, than in the Spring when outside temperatures were much higher. This suggests that it could have been the greater contrast of the classroom temperatures in the climate controlled schools with the low outside temperatures in the Fall that tended to adversely affect the students' performances. If higher room temperatures occur mostly on days with higher outside temperatures then the contrast between inside and outside temperatures in Phase II are likely to have been smallest when room temperatures in these climate controlled schools were toward the upper limits of their ranges of variation. Therefore, when the classroom temperatures in these schools were high in Phase II (and the inside-outside contrast was small) one would expect those students in a class to do well who were affected most by the more marked contrasts between inside and outside temperatures occurring at other times. Other students in the same or other classes might be influenced more by the actual temperature in the classroom. Differential responses of students such as we are suggesting could be due to many factors; for example, dressing for the outside weather rather than for conditions inside the school, engaging in differing prior activities in other parts of the school or even outside, etc.

A third question raised by the results of the analyses for the climate controlled schools is "why were there more significant correlations of academic performance with classroom air temperatures (dry bulb) in Phase II than in Phase I?" This pattern of results contrasts with the results from similar analyses with effective temperature. Classroom air temperatures were controlled in the three schools in both Phases of the study, and students reported mostly "neutral" sensations of thermal comfort in both Phases, although in each Phase more "warm" ratings occurred in Rex Putnam High School. The difference in the results cannot therefore be attributed to differences in the classroom temperatures, but rather must be again attributed to the differences in contrast of the controlled classrooms with the variable outside temperature conditions.

In Phase I on many occasions the outside temperatures were as high or higher than the controlled classroom temperatures. Throughout the month in Phase II when data were analyzed, the outside temperatures were on the average 15-20°F below the average temperatures in the climate controlled schools. In Phase I when all students must have become accustomed and their bodies adjusted to the warm weather, even those in the climate controlled school were evidently affected not only by small variations in temperature of the climate controlled classrooms, but also by variations in relative humidity, as shown by the significant correlations of their performances with effective temperature. In Phase II, when the outside temperatures were quite low for much of the time, variations in relative humidity even in the relatively warmer classrooms of the climate controlled schools had no appreciable effect on their performance levels.

In Tables X and XI are listed the "mean score" temperatures, computed from the equations defining the statistical regressions of classroom temperatures on the students' test performance measures. The "mean score" temperature is that temperature at which the students would be expected to obtain test scores equal to their individual averages for the "one-month" period. In most instances, this predicted temperature is very similar to the average of the classroom temperatures when the tests were taken. Because the performance measure used in these analyses was the deviation from an individual's average score (computed from all his scores under the particular temperature conditions at the times of the tests), we cannot compare the levels of performance of different classes or groups of students, nor should we attribute the differences in predicted "mean score temperatures" to either the subject matter of the courses, or the age and grade level of the students, but instead to differences in the classroom temperature that occurred.

To check whether students' levels of academic performance were related to their sensations of thermal comfort, test performance measures from a sample of classes were correlated with the students' thermal comfort ratings. In Appendix VI, the results of 78 of these correlations are listed. In only six cases were the correlations significant. Consequently, there is little evidence that the students' test performances were related directly to their sensations of thermal comfort.

The results of the correlations of test performance with classroom temperature do show, however, that variations in students' average levels of academic performance are reliably associated with variations in classroom temperature. This statement applies to students at the grade, junior high and high school levels, to their performance in six different courses that involve language, mathematical and general knowledge skills and to students in both non-climate controlled and climate controlled schools.

## V. SICKNESS AND ABSENCE RECORDS

### A. Introduction

The health of students in climate controlled and non-climate controlled schools is a concern for many groups of people--parents, educators, health officials, engineers and designers among others. Studies by the military in different parts of the world have repeatedly shown a relationship between high atmospheric temperatures and the incidence of sickness (Pepler, 1961) and many of the published claims for the benefit of industrial air conditioning cite reductions in accidents and absenteeism of from 10 to 20%.

But an analysis of the health and absenteeism of students in a climate controlled and two non-climate controlled schools during a study in Pinellas County, Florida (Stuart & Curtis, 1964) failed to show any difference among the schools in the incidence or pattern of illnesses and absences that could be related to climate control. Recent reports of an effect of temperature change, weather and climate on the incidence of asthma, bronchitis and rhinitis (Tromp, 1965; Greenberg, Field, Reed and Erhardt, 1966) suggest that climate control in schools might be of special benefit to children suffering from atopic disorders.

Our objective in collecting data on the frequency of health room visits and absences from the six schools in the present study was to see if there were any gross differences in these measures related to climate control. Further, we hoped to determine whether students identified as atopic would have different health and absence records in the climate controlled and non-climate controlled schools.

### B. Data Collection Procedures

Records were obtained each day of the total number of students who visited the school nurse or health room and the total number of students absent. These figures were further broken down into the total numbers who were identified as "atopic" and "non-atopic." In the written instructions to the nurses at or attending the schools in the study, they were asked to review the health records of all students and to tag as probably atopic those who reported any history of respiratory or dermatological manifestations of hypersensitivity. In addition, they were asked to check all students visiting the health room for evidence of hypersensitivity and if possible, to conduct a survey of all students directly involved in the classroom aspects of the study in order to identify the atopic students in this limited group as confidently as possible.

As well as recording daily totals of atopic and non-atopic students sick or absent throughout each school the reasons for students' visits to the health room or an absence were also recorded in the case of students participating in the classroom study. A simple set of gross categories of reasons (or symptoms) was developed and coded as follows: D=skin condition, H= headache, S=stomach symptoms, R=respiratory condition, A=injury, M= miscellaneous illness, O-other than illness. A copy of the written instructions for school nurses is attached, Appendix I.

## C. Method of Analysis

Separate correlations were run between the averages of the effective temperatures in the three classrooms at 2:00 p.m. and the numbers of atopic and non-atopic students and the total number of all students visiting the health room each day.

Similarly, correlations were also run between the maximum outside air temperature and the total numbers of students absent, and the numbers of atopic and non-atopic students absent each day. In addition, correlations were run between the numbers of students in each of these categories who were absent each day and the maximum outside temperature one and two days previously.

The reasons given for visits to the health room were tabulated separately and analyzed to determine evidence of trends and of difference in the frequencies or trends in incidence of the various reasons between atopic and non-atopic students.

## D. Main Findings

The results of the correlations of health room visits with average inside effective temperature are listed in Table XII. The frequency of visits to the school nurse or health room was quite low in all the schools, ranging from an average of 0.04% for atopic students at Rex Putnam High School to 3.5% for atopic students at Milwaukie High School. In general, there was no evidence of any differential frequency of visits between the atopic and non-atopic students, except at Ogden Junior High School. The only statistically significant correlations occurred in Phase I in Ogden Junior High and Milwaukie High School, and in Phase II a significant negative correlation for the atopic students in Rex Putnam High School, i.e., more students visited the nurse on cooler days.

The results of the correlations of students' daily absences and maximum outside air temperatures are listed in Table XIII. Correlations were performed

## Table XII

### Percentages of Health Room Visits and Their Correlations with Average Indoor Effective Temperatures

| | Non-Climate Controlled | | | | Climate Controlled | | | |
|---|---|---|---|---|---|---|---|---|
| | Phase I | | Phase II | | Phase I | | Phase II | |
| | East Gresham G.S. | | | | Powell Valley G.S. | | | |
| Atopic | Insufficient Data | | | | | | 0.8% | r=.18 |
| Non-Atopic | | | | | | | 0.9% | r=.36 |
| All Students | | | | | | | 0.9% | r=.18 |
| | Gardiner J.H.S. | | | | Ogden J.H.S. | | | |
| Atopic | 1.4% | r=-.14 | 0.9% | r=.16 | 2.4% | r=.44* | 3.1% | r=.10 |
| Non-Atopic | 1.4% | r= .07 | 1.3% | r=.01 | 1.4% | r=.47* | 1.1% | r=-.17 |
| All Students | 1.4% | r= .02 | 1.3% | r=.04 | 1.7% | r=.51** | 1.6% | r=-.05 |
| | Milwaukie H.S. | | | | Rex Putnam H.S. | | | |
| Atopic | 3.5% | r=-.10 | 3.0% | r=.35 | 0.4% | r=-.02 | 0.7% | r=-.55* |
| Non-Atopic | 3.3% | r= .49* | 2.5% | r=.19 | 0.6% | r=.00 | 0.6% | r=-.14 |
| All Students | 3.3% | r= .43* | 2.6% | r=.29 | 0.6% | r=.02 | 0.6% | r=.03 |

* P<.05
**P<.01

## Table XIII

### Percentages of Absences and Their Correlations with Maximum Outside Temperature

| | Non-Climate Controlled | | Climate Controlled | |
|---|---|---|---|---|
| | Phase I | Phase II | Phase I | Phase II |
| | East Gresham G.S. | | Powell Valley G.S. | |
| Percentage Absent | 4.7 | 3.8 | 5.6 | 4.0 |
| Same Day | r=-.06 | r=-.22 | r=-.32 | r= .25 |
| Previous Day | r=-.35 | r=-.30 | r=-.35 | r= .00 |
| 2 Days Previous | r=-.26 | r=-.34 | r=-.28 | r= .07 |
| | Gardiner J.H.S. | | Ogden J.H.S. | |
| Percentage Absent | 5.3 | 6.5 | 5.1 | 4.3 |
| Same Day | r=-.09 | r=-.01 | r=-.56** | r=-.28 |
| Previous Day | r= .14 | r=-.17 | r=-.23 | r= .03 |
| 2 Days Previous | r= .02 | r=-.20 | r=-.06 | r= .22 |
| | Milwaukie H.S. | | Rex Putnam H.S. | |
| Percentage Absent | 7.4 | 7.8 | 9.5 | 7.6 |
| Same Day | r=-.60** | r=-.25 | r=-.39* | r= .13 |
| Previous Day | r=-.34 | r=-.16 | r=-.22 | r= .03 |
| 2 Days Previous | r= .01 | r=-.43<br>(NA=-.52*) | r= .00 | r=-.31 |

* P<.05
**P<.01

between daily absences and the temperature on the same day, the previous day and two days previous for all the students and for the atopic and non-atopic students separately. The number of students absent was on the average least in the grade schools (about 4%) and greatest in high schools (about 8-9%). In these analyses, there were in Phase I significant relationships between absences and temperature of the same day in Ogden Junior High and in the two high schools. In Phase II, there was only a significant correlation between absences and the temperature two days previously for the non-atopic students in Milwaukie High School. In all cases, the correlations were negative, i. e., more absences when the temperatures were low.

The reasons for the absences of the students participating in the classroom study were also analyzed, but again, no consistent pattern emerged that distinguished the atopic and non-atopic students.

## VI. SUMMARY AND CONCLUSIONS

A study of the effects of thermal conditions in the Spring and Fall on student and teacher comfort, class behavior, student test performance and student health (visits to health room and absences) in both climate controlled and non-climate controlled schools has been completed in six suburban schools in the vicinity of Portland, Oregon.

The Spring phase of the study included several weeks of very hot weather. In the Fall, the weather was generally cool, with the average outside temperatures falling from week to week. Classroom temperatures in the non-climate controlled grade, junior high and high schools varied widely in both Spring and Fall; in the Spring, they were frequently higher and in the Fall, lower than classroom temperatures in their companion climate controlled schools.

The thermal comfort ratings of teachers and students in all six schools correlated highly with both the dry bulb air temperature and the effective temperature of the classrooms, although significant correlations were more frequent in the non-climate controlled than in the climate controlled schools and in Phase I than in Phase II of the study. Since the effective temperature scale combines the effects of temperature and humidity, the similarity of the correlations of thermal comfort ratings with dry bulb and effective temperatures indicates that at the temperatures experienced in this study, humidity had no appreciable effect on the teachers' and students' sensations of thermal comfort.

The temperatures at which teachers and students on the average reported feeling "Neither warm nor cool" in the non-climate controlled schools were lower in the Fall than in the Spring, in the mornings than in the afternoons and in the grade school than in the high school. The predicted "neutral" temperatures of the teachers and students in all schools in both phases of the study reflected the ranges of temperatures experienced. The actual distributions of the students' thermal comfort ratings in the high schools show that the range of temperatures over which most students felt "Neither warm nor cool" was broader in the non-climate controlled schools, was lower in the Fall than in the Spring (especially in the afternoon periods), was narrower for female than for male students, and was higher in the mornings than in the afternoons, i.e., students tended to feel comfortable at higher temperatures in morning than in afternoon periods.

The generally lower range of temperatures in the afternoons over which most students are "Neither warm nor cool" presumably reflects the normal daily rise in body temperature. The greater prominence of this morning/

afternoon difference in the Fall was possibly related to the greater contrast with the cooler outside temperatures.

In a number of instances in Phase II, the students' thermal comfort ratings were shown to be positively correlated not with classroom temperatures, but with the difference between these temperatures and the daily maximum outside temperature.

There was generally no difference between the predicted "neutral" temperatures of teachers and students. In most cases, these "neutral" temperatures were 2-6°F lower than the 78°F dry bulb temperature recommended by the K. S. U. workers for thermally "neutral" conditions. However, some evidence was obtained that, although the predicted "neutral" temperatures of female students were generally similar to the male students in their classes, the female students were more sensitive to variations in classroom temperatures, and were comfortable over a narrower range of temperatures than the male students (especially in the morning periods). Evidence was also obtained that among the grade school and junior high school students in the Spring, the atopic students were more sensitive than the non-atopic students in their classes to differences in classroom temperatures.

It should perhaps be pointed out that the greater thermal sensitivity of the female students could be related not only to pirmary sex differences but also to differences in the insulating value of their clothing. Such differences between the sexes are likely to be greatest in Spring and Fall when clothing styles may be determined more by fashion than by the actual weather.

Teachers' ratings of their classes' "responsiveness" were found to correlate significantly with classroom effective temperatures. Classroom temperatures clearly affected these ratings, but unfortunately we do not know whether the temperatures did in fact affect class behavior, or the teachers' own perceptions of their classes and/or their use of the scale or some combination of these.

Daily variations in classroom temperatures affected the students' test performances in schools at all three grade levels. During Phase I, the students in the non-climate controlled schools did less well in their course work when the classroom temperatures were high. In Phase II, the students in these same schools were generally unaffected by variations in classroom temperatures. Quite unexpectedly, the study showed that the much smaller variations in classroom temperature in the climate controlled schools also affected student test performances. This effect occurred in every course, but in two cases, in Phase I and four cases in Phase II, the effect was in the opposite direction to that in the non-climate controlled schools, i. e., the students tended to do better on days with higher classroom temperatures. Clearly, air conditioning in schools in the Portland area did not eliminate all influences of temperature variations on student scholastic performances. It did, however, change and possibly complicate the nature of these influences. It seems that a number of students in the climate controlled schools were more affected by the contrast between inside and outside temperatures than by the variations in temperature of the climate controlled classrooms.

The incidence of visits to the school nurse or health room was generally low in all the schools. Only in two schools in Phase I and one school in Phase II was the frequency of visits correlated significantly with variations in inside temperature. The students' absence rate ranged from about 4% at the grade school level to 8-9% at the high school level. In Phase I in one junior high and in the two high schools, significantly more students were absent on the cooler days. In Phase II, only the absences of the atopic students in the Rex Putnam High School were significantly correlated with daily temperatures. The evidence of any effect of temperature on the students' health as judged by visits to the school nurse and absences was therefore slight; there was no evidence that the health of any group of students was more affected by variations in temperatures in the non-climate controlled than in the climate controlled schools.

In general, ~~the study has shown~~ that students and teachers in climate controlled schools are comfortable much more of the time than their counterparts in the non-climate controlled schools, but that they become more sensitive to small changes in classroom temperature. Students in non-climate controlled schools tend to work less well in periods of hot weather when their classrooms are unusually warm. The academic performances of students in climate controlled schools are also affected by variations in temperature, but they seem to be more influenced by the contrast between inside and outside temperature than by variations in their classroom temperatures. Fluctuations in temperature in Spring and Fall did not appear to affect the health of students in these six schools in the Pacific Northwest.

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# APPENDIX I

## Written Instructions for Data Collection

# A RESEARCH STUDY OF CLIMATE CONTROL IN SCHOOLS

## GENERAL INSTRUCTIONS FOR PROJECT SECRETARIES

The Oregon State Department of Education is cooperating with the American Society of Heating, Refrigerating and Air Conditioning Engineers in supporting a study of the effects of climate control (air conditioning) in schools. The Society has contracted with the research and consulting firm of Dunlap and Associates, Inc., to plan, carry out, and report on the results of the study.

Six schools in the Portland area have been selected as sites for this joint research project. The program of research calls for three different but related sets of activities; a survey of teacher opinions about climate control, a classroom study of student comfort, class behavior and student learning performance, and a study of sickness and absences over a nine-week marking period in the Spring and the Fall.

An individual at each school has been appointed project secretary and will perform a key role in the project. She has two major functions to perform. Firstly, the project secretary will support the classroom study. You will do this by 1) providing each of the teachers daily with the necessary forms for collecting student and teacher ratings of comfort and teacher ratings of class behavior, 2) collecting the classroom study data from the teachers each day (including the students' test scores two days a week), 3) transferring the ratings and test scores to the special summary data sheets provided and 4) mailing these data sheets to Dunlap and Associates, Inc., every week. You will keep the classroom study "raw" data on file until after the finish of the complete project. We might need to check the original records during data analysis to verify any apparently anomalous values among the data.

Secondly, as project secretary, you will be responsible for duplicating for the project daily records of student (and teacher) absences and of student visits to the health room or school nurse. You will note the reason for each health visit or absence using a set of agreed abbreviations and the identification of each "case" as atopic or non-atopic. Weekly summaries of absences and health visits will be mailed to Dunlap and Associates, Inc., using the special forms provided.

To perform this second function effectively, project secretaries will have to work with the school nurses and attendance secretaries to determine the reasons for the absences and health visits of the individual students participating in the classroom study, and with the help of school nurses identify the atopic or "sensitive" students throughout the schools.

Project secretaries should be familiar with the locations of the classrooms to be used in the classroom study, should know the teachers involved in the study and the numbers of students in each class. They should arrange with the teachers to collect the students' percentage scores from the two tests each week, and generally agree on arrangements for delivering the rating forms and collecting the data from each classroom in the study.

The school nurses (or school secretaries when appropriate) are being asked to maintain a daily record of all visits by students to the health room, and of the reasons for each visit. They are also being asked to instruct you in how to identify the "sensitive" students.

In summary, project secretaries will:

1. Support the classroom study by:
   - a. distributing data collection forms to teachers
   - b. collecting data from the teachers
   - c. preparing weekly summaries of the data
   - d. mailing the summary forms to Dunlap and Associates, Inc., every week.
2. Collect data for the study of school absence and sickness records by:
   - a. maintaining duplicate records of daily absences and visits to the health room
   - b. identifying the numbers of atopic students in the school and the atopic students who are absent or visit the health room
   - c. preparing weekly summaries of absences and health room visits
   - d. mailing these completed summary forms to Dunlap and Associates, Inc., every week.

Any initial problems you have with these procedures should be discussed with Dr. R.D. Pepler, the director of the research project, during his visit to the school or reported to your school principal. Thank you for undertaking such a responsible role in this research project.

## TEACHERS' INSTRUCTIONS
## GENERAL PROCEDURES FOR CLASSROOM STUDY

A study of student comfort, class behavior and learning performance is a major element of the research sponsored jointly by the Oregon State Department of Education and the American Society of Heating, Refrigerating and Air Conditioning Engineers into climate control in schools.

The design of the classroom study calls for the collection of data on student comfort and class behavior on a daily basis and data on student learning performance on standard tests at least two times a week over a nine-week marking period. These behavioral data will be related to records of the temperature and humidity of the air in the classroom. A special instrument has been installed in your classroom by Portland General Electric Company which maintains continuous records of air temperature and humidity.

The research project will employ a secretary at each participating school. The project secretary in your school will provide you with an adequate supply of forms for collecting student comfort and class behavior ratings, and will collect all completed forms from you (including the students' test scores).

We do not want the students to know that you are rating class behavior nor that their test scores will be related to classroom temperature and humidity readings. The less students know about these aspects of the study the less their behavior and test performances are likely to be biased.

At the start of the nine-week marking period, you should tell each class that they will be participating in a study of "Thermal Comfort in Schools." Explain that the temperature/humidity recorder was placed in the room to provide data for this study, and that from now on at the end of the lesson you will be asking them to record their sensations of thermal comfort using a special Thermal Comfort Scale that will be provided. Attached you will find descriptive material you can use to instruct your students in how to record their thermal sensations using the Thermal Comfort Scale. Toward the end of the lessons with each participating class you should hand out the "Thermal Comfort" forms and for the first one or two lessons go over the instructions with the class on how to fill them out. The students should quickly learn how to use the forms and will probably then only need an occasional reminder to sign the completed forms before handing them back to you.

Every time that you have a class which is participating in the study would you also complete a Thermal Comfort reporting form at the end of the lesson while the students are completing theirs. Then complete the Class Behavior rating form (see attached instructions) before collecting the students' comfort reports. For those days when a class has one of the standard tests, please arrange a mutually convenient procedure for giving the school's project secretary each student's percentage score. The school's project secretary has the responsibility of transposing all data from the classroom study onto special summary data sheets and mailing these to Dunlap and Associates, Inc., weekly. She has other project duties, but she has a major responsibility of relieving the teachers in the classroom study from the clerical work of handling the data collected.

In summary, teachers participating in the classroom study are asked to do the following:

1. Collect thermal comfort ratings daily from all students in the participating classes.
2. Complete a thermal comfort rating every time students are giving their ratings.
3. Rate the general behavior of participating classes daily on the scale provided.
4. Give each participating class standard tests on the course at least two times a week and record student's performances in the form of percentage scores.

Any initial problems you have with these procedures should be discussed with Dr. Richard Pepler, the director of the research project, during his visit to the school or reported to your school principal. Thank you again for undertaking such a key role in this research project.

(Please check each day that the temperature/humidity recorder is marking the paper and that the times shown on the paper are correct. If not, have the secretary call Mr. Hansen or Mr. Jarrett of PGE at 228-7184.)

## A RESEARCH STUDY OF CLIMATE CONTROL IN SCHOOLS

## GENERAL INSTRUCTIONS FOR SCHOOL NURSES

The Oregon State Department of Education is cooperating with the American Society of Heating, Refrigerating and Air Conditioning Engineers in supporting a study of the effects of climate control (air conditioning) in schools. The Society has contracted with the research and consulting firm of Dunlap and Associates, Inc., to plan, carry out, and report on the results of the study.

Six schools in the Portland area have been selected as sites for this joint research project. The program of research calls for three different but related sets of activities; a survey of teacher opinions about climate control, a classroom study of student comfort, class behavior and student learning performance, and a study of sickness and absences over a nine-week marking period in the Spring and the Fall. An individual at each school has been appointed project secretary. She has two major functions to perform; 1) to provide clerical support for the teachers in the classroom study, and 2) to collect and calculate daily records of student (and teacher) absences and student visits to the health room or school nurse. She has been instructed to note down the reasons for each health visit or absence using a set of agreed abbreviations, and to identify each "case" as atopic or non-atopic. Weekly summaries of absences and health visits will be mailed to Dunlap and Associates, Inc., using the special forms provided.

To perform this second function effectively, project secretaries will need the cooperation of the school nurses and attendance secretaries to determine the reasons for the absences and health visits of individual students participating in the classroom study. They will also need directions from school nurses on how to identify the atopic or "sensitive" students throughout the schools.

Your participation in this research is essential for its success, but we hope that the demands on your time will not be burdensome. The plan is that the project secretaries will extract the required data once they have been shown where and how to find the necessary information. In some cases, it may be necessary to establish a procedure for collecting pertinent information if these do not presently exist.

The research program has a special interest in the reactions of the atopic or "sensitive" students. We would, therefore, like you to review the Health

Record Cards of the students in your school to be sure that the cards of all those with any history of respiratory or dermatological manifestations of hypersensitivity be "tagged" as probably atopic. You should include in this category students with signs of bronchial asthema, nonseasonal sinusitis, atopic dermatitis (infantile eczema), hay fever and other allergies. In all probability the students already identified as "sensitive" will be those who are most severely affected and in some degree functionally handicapped. We would like you to include in the atopic category students with less severe symptoms. We are proposing two additional procedures that might detect less severely affected students.

Firstly, would you routinely ask all students who visit the health room, if they have any history of respiratory or dermatological manifestations of hypersensitivity and would you observe and record any current signs of shortness of breath, wheezing, prolonged expirations or skin irritations. Secondly, if possible would you institute a small scale survey of all students directly involved in the classroom study in your school to indentify as confidently as possible for this limited group the atopic and the non-atopic students.

To help the project secretary record the reasons for visits to the health room or for absences could you prepare some simple letter code by which she can identify them in her weekly summary forms. Thse codes can be coordinated among the six schools participating in the study during the first week or two of the study.

In summary, nurses at the schools participating in this research program are being asked to give guidance to the project secretaries in collecting data on health visits and absences, and specifically to:

1. Maintain a daily record of all students who visit the school clinic or health room and the reasons for their visits.

2. Identify by inquiry and observation students visiting the health room who have signs and symptoms of some degree of hypersensitivity.

3. Review the Health Record Cards of all students and tag those with recorded evidence of hypersensitivity.

4. Conduct, if possible, a small survey of all students involved directly in the classroom study to identify as confidently as possible the atopic and non-atopic students.

Any problems you have in instituting those procedures should be discussed with Dr. Richard Pepler, the director of the project during his visit to your school at the beginning of the project or reported to your school principal. Thank you for undertaking to participate in this program of research.

# TEACHERS' INSTRUCTIONS FOR COLLECTING STUDENT THERMAL COMFORT RATINGS

We would like to obtain Thermal Comfort ratings among all classes participating in the classroom study. Toward the end of the first meeting with such classes tell the students about the project, hand out the "Thermal Comfort" rating forms, and instruct the students in their proper use. An example of what you might tell the students is as follows:

> "During the rest of this year, several classes will be taking part in a research project to study student comfort in schools; our class is one of those selected.
>
> "A special recording instrument has been placed in the classroom which provides a continuous record of temperature and humidity. At the end of every class, you will be asked to report your sensation of thermal comfort, that is to say--how hot or cold you feel.
>
> "I am handing out slips of paper on which a Thermal Comfort Scale is printed. As you see, it has seven points on a scale that runs from '1, cold,' to '7, hot.' The mid-point in the scale that is #4 represents a feeling of being neither hot or cold. You are to circle the number on the scale that corresponds most closely to how you now feel. Then fill in your name, the room number, date, and time. Sign your name at the bottom, and hand in the completed slip to me. Please do not discuss with your friends how you feel before marking the scale. Very often people sitting next to one another feel quite differently. We want to get a record of how each one of you feels--individually."

Be sure to remind the students to sign their names and fill in the day's date and time.

While the students are doing this, you should also fill out one of the Thermal Comfort rating forms yourself, and complete the Class Behavior rating form. After students have used the Thermal Comfort Scale once or twice, it should become routine for them and not take very much time to complete.

## TEACHERS' INSTRUCTIONS FOR RATING CLASS BEHAVIOR

As part of our study of the effects of thermal conditions on students' behavior, we would like teachers to furnish us a daily assessment of students' general level of responsiveness in their classes.

The term "responsiveness" refers to that fairly vague but common feeling that all teachers experience about how students react from one class to another and one day to another. It includes perhaps such things as attentiveness, degree of participation or the degree of student involvement in the learning process. There are times, for example, when students appear disinterested, restless, etc., and others when they are quite attentive and cooperative.

We realize, of course, that students' "responsiveness" or involvement is a difficult thing to rate--surely, it's a very subjective kind of thing but one for which teachers seem to have a good feeling. We would like your help in trying to obtain this type of measure on each class with whom you meet each day.

To do this, we have developed a form which allows for rating each classes' "involvement" or "responsiveness" on a nine (9) point scale from "very high" to "very low."

Please make a rating at the conclusion of each class period simply by circling the number corresponding to the level of "responsiveness" you felt the class exhibited during that period. Also fill in the identifying information including: 1) your name, 2) class period, 3) the date, and 4) the time of day.

Please note that we have also included a space for you to include mention of any unusual happenings or conditions which you feel may have accounted for an unusually bad day for the students. If your rating of responsiveness is below average (that is, 1-4 on the scale) and you feel that some factor such as the noise level outside might have distracted the students, then please tell us about this in the space provided. Please sign the form after you have made your rating.

# APPENDIX II

## Results of Correlations between Thermal Comfort Ratings and Classroom Temperatures

| | |
|---|---|
| Phase I | Dry Bulb Air Temperature<br>Effective Temperature |
| Phase II | Dry Bulb Air Temperature<br>Effective Temperature |

### Phase I
### East Gresham Grade School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| All Period 5/ | F | .320 | 854 | .01 | 72.48 | 67-81 |
| Combined | M | .277 | 858 | .01 | 72.53 | 67-81 |
| All Teachers | | .435 | 70 | .01 | 72.42 | 67-81 |

### Phase II
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| All Period 5/ | F | .294 | 854 | .01 | 66.35 | 61-73 |
| Combined | M | .261 | 858 | .01 | 66.34 | 61-73 |
| All Teachers | | .339 | 70 | .01 | 66.33 | 61-73 |

### Phase II
### East Gresham Grade School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spelling/5 (S) | F | .217 | 212 | .01 | 71.20 | 66-75 |
| Spelling/5 (S) | M | .147 | 233 | .05 | 71.16 | 66-75 |
| Spelling/5 (H) | F | .042 | 197 | NS | | 69-74 |
| Spelling/5 (H) | M | .088 | 222 | NS | | 69-74 |
| Spelling/5 (C) | F | .088 | 150 | NS | | 68-76 |
| Spelling/5 (C) | M | .226 | 225 | .01 | 71.90 | 68-76 |
| All 3 classes Combined/5 | F | .193 | 563 | .01 | 71.44 | 66-76 |
| | M | .176 | 684 | .01 | 71.43 | 66-76 |
| All 3 teachers Combined/5 | | .374 | 47 | .01 | 71.57 | 66-76 |

## Phase II
## East Gresham Grade School
## Non-Climate Controlled
## Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spelling/5 (S) | F | .244 | 211 | .01 | 65.88 | 60-70 |
| Spelling/5 (S) | M | .160 | 233 | .05 | 65.81 | 60-70 |
| Spelling/5 (H) | F | .053 | 196 | N.S. | | 62-70 |
| Spelling/5 (H) | M | .110 | 223 | N.S. | | 62-70 |
| Spelling/5 (C) | F | .060 | 150 | N.S. | | 63-71 |
| Spelling/5 (C) | M | .205 | 225 | .01 | 66.47 | 63-71 |
| All 3 classes<br>Combined/5 | F<br>M | .183<br>.163 | 561<br>685 | .01<br>.01 | 65.83<br>65.94 | 60-71<br>60-71 |
| All 3 teachers Combined/5 | | .371 | 51 | .01 | 66.15 | 60-71 |

### Phase I
### Gardiner Junior High School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<, | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/1 (A) | F | .019 | 252 | NS | | 71-75 |
| Social/1 (A) | M | .103 | 197 | NS | | 71-75 |
| Social/1 (B) | F | .233 | 361 | .01 | 73.11 | 70-76 |
| Social/1 (B) | M | .032 | 246 | NS | | 70-76 |
| Spanish/1 (W) | F | .098 | 278 | NS | | 69-77 |
| Spanish/1 (W) | M | .141 | 276 | .05 | 73.56 | 69-77 |
| All Period 1 Combined | F | .169 | 895 | .01 | 73.16 | 69-77 |
| | M | .131 | 723 | .01 | 73.12 | 69-77 |
| Social/7 (A) | F | .502 | 139 | .01 | 76.09 | 74-81 |
| Social/7 (A) | M | .363 | 283 | .01 | 76.32 | 74-81 |
| All Teachers | | .406 | 231 | .01 | 74.59 | 69-81 |
| | A/NA | | | | | |
| Social/1 (B) | A | .420 | 214 | .01 | 73.17 | 70-76 |
| Social/1 (B) | NA | .085 | 392 | NS | | 70-76 |
| Spanish/1 (W) | A | .105 | 403 | .05 | 73.70 | 69-77 |
| Spanish/1 (W) | NA | .147 | 150 | NS | | 69-77 |
| Spanish/3 (W) | A | .316 | 338 | .01 | 75.63 | 72-79 |
| Spanish/3 (W) | NA | .180 | 269 | .01 | 76.11 | 72-79 |
| Social/7 (A) | A | .427 | 132. | .01 | 76.23 | 74-81 |
| Social/7 (A) | NA | .415 | 297 | .01 | 76.25 | 74-81 |

### Phase I
### Gardiner Junior High School
### Non-Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spanish/1 (W) | F | .081 | 278 | NS | | 63.5-71 |
| Spanish/1 (W) | M | .107 | 276 | NS | | 63.5-71 |
| All Period 1 Combined | F<br>M | .338<br>.103 | 895<br>723 | .01<br>NS | 67.21 | 64-71<br>64-71 |
| Spanish/3 (W) | F | .192 | 420 | .01 | 69.17 | 65.5-72 |
| Spanish/3 (W) | M | .203 | 187 | .01 | 69.12 | 65.5-72 |
| Social/6 (B) | F | .209 | 354 | .01 | 69.98 | 68-74 |
| Social/6 (B) | M | .082 | 385 | NS | | 68-74 |
| Social/7 (A) | F | .226 | 139 | .05 | 69.13 | 66-74 |
| Social/7 (A) | M | .328 | 283 | .01 | 68.90 | 66-74 |
| All Teachers | | .393 | 231 | .01 | 67.86 | 63-74 |
| | A/NA | | | | | |
| Social/1 (B) | A | .192 | 214 | .01 | 67.09 | 65-70 |
| Social/1 (B) | NA | .035 | 392 | NS | | 65-70 |
| Spanish/1 (W) | A | .088 | 403 | NS | | 63.5-71 |
| Spanish/1 (W) | NA | .119 | 150 | NS | | 63.5-71 |
| Spanish/3 (W) | A | .253 | 338 | .01 | 68.96 | 65.5-72 |
| Spanish/3 (W) | NA | .147 | 269 | .05 | 69.31 | 65.5-72 |
| Social/7 (A) | A | .359 | 132 | .01 | 68.80 | 66-74 |
| Social/7 (A) | NA | .343 | 297 | .01 | 68.84 | 66-74 |

### Phase II
### Gardiner Junior High School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/1 (A) | F | .011 | 208 | NS | | 66-74 |
| Social/1 (A) | M | .005 | 315 | NS | | 66-74 |
| Social/1 (B) | F | .370 | 238 | .01 | 70.75 | 62-74 |
| Social/1 (B) | M | .272 | 274 | .01 | 70.70 | 62-74 |
| Spanish/1 (W) | F | .317 | 56 | .05 | 73.74 | 70-77 |
| Spanish/1 (W) | M | .116 | 98 | NS | | 70-77 |
| All Period 1 Combined | F | .188 | 506 | .01 | 70.56 | 62-77 |
| | M | .106 | 686 | .01 | 70.59 | 62-77 |
| Social/2 (A) | F | .315 | 143 | .01 | 71.47 | 68-74 |
| Social/2 (A) | M | -.035 | 371 | NS | | 68-74 |
| Social/2 (B) | F | -.026 | 259 | NS | | 70-78 |
| Social/2 (B) | M | .056 | 285 | NS | | 70-78 |
| Spanish/2 (W) | F | .204 | 67 | NS | | 70-78 |
| Spanish/2 (W) | M | .001 | 98 | NS | | 70-78 |
| All Period 2 Combined | F | -.005 | 473 | NS | | 68-78 |
| | M | .167 | 758 | .01 | 72.71 | 68-78 |
| Spanish/3 (W) | F | .283 | 233 | .01 | 73.85 | 68-80 |
| Spanish/3 (W) | M | .232 | 160 | .01 | 74.44 | 68-80 |
| Social/7 (A) | F | .005 | 430 | NS | | 72-78 |
| Social/7 (A) | M | -.141 | 160 | NS | | 72-78 |
| All Teachers | | .256 | 181 | .01 | 72.68 | 62-80 |
| | A/NA | | | | | |
| Social/1 (B) | A | .188 | 95 | NS | | 62-74 |
| Social/1 (B) | NA | .347 | 417 | .01 | 70.81 | 62-74 |
| Spanish/2 (W) | A | .024 | 80 | NS | | 70-78 |
| Spanish/2 (W) | NA | .112 | 85 | NS | | 70-78 |

### Phase II
### Gardiner Junior High School
### Non-Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/1 (A) | F | .034 | 208 | N.S. | | 59.5-68 |
| Social/1 (A) | M | -.023 | 305 | N.S. | | 59.5-68 |
| Social/1 (B) | F | .356 | 238 | .01 | 64.84 | 56-69 |
| Social/1 (B) | M | .255 | 274 | .01 | 64.95 | 56-69 |
| Spanish/1 (W) | F | .284 | 59 | .05 | 66.41 | 62-70 |
| Spanish/1 (W) | M | .102 | 101 | N.S. | | 62-70 |
| All Period 1 Combined | F | .212 | 509 | .01 | 64.64 | 56-70 |
| | M | .111 | 684 | .01 | 64.71 | 56-70 |
| Social/2 (A) | F | .319 | 143 | .01 | 65.40 | 61-69 |
| Social/2 (A) | M | -.040 | 371 | N.S. | | 61-69 |
| Social/2 (B) | F | .001 | 259 | N.S. | | 63-72 |
| Social/2 (B) | M | .047 | 285 | N.S. | | 63-72 |
| Spanish/2 (W) | F | .180 | 60 | N.S. | | 62-71 |
| Spanish/2 (W) | M | -.049 | 96 | N.S. | | 62-71 |
| All Period 2 Combined | F | .009 | 474 | N.S. | | 61-72 |
| | M | .120 | 758 | .01 | 66.61 | 61-72 |
| Spanish/3 (W) | F | .206 | 233 | .01 | 67.26 | 63-72 |
| Spanish/3 (W) | M | .202 | 158 | .05 | 67.53 | 63-72 |
| Social/7 (A) | F | -.071 | 426 | N.S. | | 64-71 |
| Social/7 (A) | M | -.244 | 161 | .01 | 68.36 | 64-71 |
| All Teachers | | .286 | 189 | .01 | 66.09 | 56-72 |
| | A/NA | | | | | |
| Social/1 (B) | A | .215 | 95 | .05 | 64.87 | 56-69 |
| Social/1 (B) | NA | .323 | 417 | .01 | 64.89 | 56-69 |
| Spanish/2 (W) | A | -.003 | 80 | NS | | 62-71 |
| Spanish/2 (W) | NA | .087 | 85 | NS | | 62-71 |

### Phase I
### Milwaukie High School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Geom. /1 | F | .260 | 279 | .01 | 75.42 | 69-81 |
| Geom. /1 | M | .268 | 328 | .01 | 75.33 | 69-81 |
| F. Math/1 | F | .112 | 190 | NS | | 74-85 |
| F. Math/1 | M | .094 | 242 | NS | | 74-85 |
| Latin III/1 | F | .625 | 36 | .01 | 72.97 | 68-76 |
| Latin III/1 | M | .508 | 151 | .01 | 72.72 | 68-76 |
| All Period 1 | F | .321 | 509 | .01 | 75.84 | 68-85 |
| Combined | M | .373 | 726 | .01 | 75.37 | 68-85 |
| Geom. /5 | F | .655 | 310 | .01 | 78.34 | 75-86 |
| Geom. /5 | M | .736 | 261 | .01 | 78.40 | 75-86 |
| Gen. Math/5 | F | .410 | 30 | .05 | 79.15 | 74-86 |
| Gen. Math/5 | M | .572 | 142 | .01 | 77.60 | 74-86 |
| Latin I/5 | F | .533 | 106 | .01 | 77.50 | 72-85 |
| Latin I/5 | M | .648 | 161 | .01 | 76.45 | 72-85 |
| All Period 5 | F | .601 | 450 | .01 | 78.17 | 72-86 |
| Combined | M | .628 | 568 | .01 | 77.68 | 72-86 |
| All Teachers | | .719 | 319 | .01 | 76.11 | 68-89 |
| | A/NA | | | | | |
| Geom. /1 | A | .281 | 343 | .01 | 73.41 | 69-81 |
| Geom. /1 | NA | .236 | 256 | .01 | 75.38 | 69-81 |
| Latin III/1 | A | .566 | 83 | .01 | 72.90 | 68-76 |
| Latin III/1 | NA | .527 | 109 | .01 | 72.67 | 68-76 |
| Geom. /5 | A | .654 | 247 | .01 | 78.45 | 68-76 |
| Geom. /5 | NA | .715 | 325 | .01 | 78.28 | 68-76 |
| Latin I/5 | A | .634 | 136 | .01 | 76.97 | 72-85 |
| Latin I/5 | NA | .581 | 131 | .01 | 76.81 | 72-85 |

## Phase I
## Milwaukie High School
## Non-Climate Controlled
## Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Geom. /1 | F | .251 | 279 | .01 | 69.11 | 63-79 |
| Geom. /1 | M | .167 | 328 | .01 | 68.57 | 63-79 |
| F. Math/1 | F | .126 | 190 | NS | | 64-75 |
| F. Math/1 | M | .258 | 242 | .01 | 69.27 | 64-75 |
| Latin III/1 | F | .369 | 36 | .05 | 66.19 | 63-70 |
| Latin III/1 | M | .295 | 151 | .01 | 66.13 | 63-70 |
| All Period 1 | F | .287 | 509 | .01 | 68.67 | 63-75 |
| Combined | M | .335 | 726 | .01 | 68.24 | 63-75 |
| Geom. /5 | F | .644 | 310 | .01 | 70.55 | 68-76 |
| Geom. /5 | M | .737 | 261 | .01 | 70.53 | 68-76 |
| Gen. Math/5 | F | .435 | 30 | .05 | 70.55 | 67-75 |
| Gen. Math/5 | M | .575 | 142 | .01 | 69.44 | 67-75 |
| Latin I/5 | F | .488 | 106 | .01 | 69.76 | 66-75 |
| Latin I/5 | M | .583 | 161 | .01 | 69.12 | 66-75 |
| All Period 5 | F | .572 | 450 | .01 | 70.35 | 66-76 |
| Combined | M | .583 | 568 | .01 | 69.95 | 66-76 |
| All Teachers | | .423 | 319 | .01 | 69.11 | 63-79 |
| | A/NA | | | | | |
| Geom. /1 | A | .276 | 343 | .01 | 68.62 | 63-73 |
| Geom. /1 | NA | .235 | 256 | .01 | 68.61 | 63-73 |
| Latin III/1 | A | .327 | 83 | .01 | 66.20 | 63-70 |
| Latin III/1 | NA | .291 | 109 | .01 | 66.11 | 63-70 |
| Geom. /5 | A | .644 | 247 | .01 | 70.61 | 68-76 |
| Geom. /5 | NA | .710 | 325 | .01 | 71.43 | 68-76 |
| Latin I/5 | A | .577 | 136 | .01 | 69.43 | 66-75 |
| Latin I/5 | NA | .526 | 131 | .01 | 69.36 | 66-75 |

### Phase II
### Milwaukie High School
### Non-Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Latin I/1 | F | .196 | 199 | .01 | 70.90 | 66-73 |
| Latin I/1 | M | .233 | 110 | .05 | 70.79 | 66-73 |
| Gen. Math/1 | F | .272 | 251 | .01 | 74.59 | 72-78 |
| Gen. Math/1 | M | .172 | 165 | .05 | 74.75 | 72-78 |
| Latin III/4 | F | -.065 | 69 | NS | | 72-76 |
| Latin III/4 | M | .148 | 84 | NS | | 72-76 |
| Geom. /4 | F | .086 | 247 | NS | | 73-78 |
| Geom. /4 | M | .079 | 250 | NS | | 73-78 |
| All Period 4 Combined | F | .105 | 318 | NS | | 72-78 |
| | M | .137 | 336 | .05 | 74.95 | 72-78 |
| Gen. Math/7 | F | .306 | 264 | .01 | 75.39 | 71-80 |
| Gen. Math/7 | M | .371 | 162 | .01 | 75.67 | 71-80 |
| All Teachers | | .129 | 223 | NS | | 66-80 |
| | A/NA | | | | | |
| Gen. Math/1 | A | .158 | 180 | .05 | 74.72 | 72-78 |
| Gen. Math/1 | NA | .296 | 236 | .01 | 74.61 | 72-78 |
| Gen. Math/7 | A | .298 | 110 | .01 | 75.54 | 71-80 |
| Gen. Math/7 | NA | .341 | 316 | .01 | 75.49 | 71-80 |

## Phase II
## Milwaukie High School
## Non-Climate Controlled
## Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Gen. Math/1 | F | .193 | 256 | .01 | 68.06 | 66-70.5 |
| Gen. Math/1 | M | .162 | 171 | .05 | 68.17 | 66-70.5 |
| Geom. /1 | F | .119 | 300 | .05 | 67.28 | 62.5-70 |
| Geom. /1 | M | .083 | 248 | N.S. | | 62.5-70 |
| LatinI/1 | F | .169 | 193 | .05 | 65.11 | 61.5-66.5 |
| LatinI/1 | M | .325 | 115 | .01 | 65.11 | 61.5-66.5 |
| All Period 1 | F | .291 | 753 | .01 | 66.90 | 61,5-70.5 |
| Combined | M | .196 | 538 | .01 | 67.07 | 61.5-70.5 |
| Geom. /4 | F | .129 | 246 | N.S. | | 65-70 |
| Geom. /4 | M | .056 | 250 | N.S. | | 65-70 |
| Latin III/4 | F | .085 | 69 | N.S. | | 65-70 |
| Latin III/4 | M | .032 | 84 | N.S. | | 65-70 |
| All Period 4 | F | .145 | 317 | .05 | 68.11 | 65-70 |
| Combined | M | .077 | 335 | N.S. | | 65-70 |
| Gen. Math/7 | F | .261 | 264 | .01 | 68.66 | 66-72 |
| Gen. Math/7 | M | .283 | 162 | .01 | 68.89 | 66-72 |
| Geom. /7 | F | .462 | 306 | .01 | 68.28 | 65-72 |
| Geom. /7 | M | .373 | 175 | ,01 | 68.60 | 65-72 |
| All Period 7 | F | .365 | 572 | .01 | 68.43 | 65-72 |
| Combined | M | .315 | 339 | .01 | 68.76 | 65-72 |
| All Classes--<br>All Periods (1-7) | Teachers | .218 | 210 | .01 | 67.60 | 61.5-72 |
| | **A/NA** | | | | | |
| Gen. Math/1 | A | .099 | 180 | NS | | 66-70.5 |
| Gen. Math/1 | NA | .246 | 236 | .01 | 68.10 | 66-70.5 |
| Gen. Math/7 | A | .286 | 110 | .01 | 68.68 | 66-72 |
| Gen. Math/7 | NA | .262 | 316 | .01 | 68.78 | 66-72 |

### Phase I
### Powell Valley Grade School
### Climate Controlled
### Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| All Teachers |  | -.287 | .70 | .05 | 74.00 | 73-76 |
|  | A/NA |  |  |  |  |  |
| Spelling/5 (S) | A | .080 | 99 | NS |  | 74-75 |
| Spelling/5 (S) | NA | .030 | 385 | NS |  | 74-75 |
| Spelling/5 (N) | A | .097 | 135 | NS |  | 73-74 |
| Spelling/5 (N) | NA | -.005 | 353 | NS |  | 73-74 |
| Spelling/5 (N1) | A | -.111 | 89 | NS |  | 74-76 |
| Spelling/5 (N1) | NA | -.096 | 419 | NS |  | 74-76 |

### Phase I
### Powell Valley Grade School
### Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spelling/5 (N1) | F | -.070 | 235 | NS |  | 67-69 |
| Spelling/5 (N1) | M | -.042 | 263 | NS |  | 67-69 |
| All Teachers |  | -.317 | 70 | .01 | 67.01 | 66-69 |
|  | A/NA |  |  |  |  |  |
| Spelling/5 (S) | A | -.075 | 99 | NS |  | 66-67.5 |
| Spelling/5 (S) | NA | .070 | 385 | NS |  | 66-67.5 |
| Spelling/5 (N) | A | .083 | 135 | NS |  | 66-68 |
| Spelling/5 (N) | NA | .062 | 353 | NS |  | 66-68 |
| Spelling/5 (N1) | A | .021 | 89 | NS |  | 67-69 |
| Spelling/5 (N1) | NA | -.062 | 419 | NS |  | 67-69 |

## Phase II
## Powell Valley Grade School
## Climate Controlled
## Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spelling/5 (S) | F | -.062 | 274 | NS | | 74-76 |
| Spelling/5 (S) | M | .050 | 126 | NS | | 74-76 |
| Spelling/5 (J) | F | .017 | 291 | NS | | 72-77 |
| Spelling/5 (J) | M | .113 | 159 | NS | | 72-77 |
| Spelling/5 (N) | F | -.100 | 218 | NS | | 74-76 |
| Spelling/5 (N) | M | -.027 | 206 | NS | | 74-76 |
| All Period 5 Combined | F | -.014 | 787 | NS | | 72-77 |
| | M | .046 | 495 | NS | | 72-77 |
| All 3 teachers Combined/5 | | -.016 | 52 | NS | | 72-77 |

### Phase II
### Powell Valley Grade School
### Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Spelling/5 (S) | F | .015 | 279 | N.S. | | 67-70 |
| Spelling/5 (S) | M | .062 | 126 | N.S. | | 67-70 |
| Spelling/5 (J) | F | -.028 | 291 | N.S. | | 66-70 |
| Spelling/5 (J) | M | .040 | 159 | N.S. | | 66-70 |
| Spelling/5 (N) | F | -.169 | 215 | .05 | 68.17 | 66.5-70 |
| Spelling/5 (N) | M | -.091 | 209 | N.S. | | 66.5-70 |
| All Period 5 Combined | F | -.044 | 789 | N.S. | | 66-70 |
| | M | -.011 | 498 | N.S. | | 66-70 |
| All Period 5 Combined | Teachers | .051 | 47 | N.S. | | 66-70 |

### Phase I
### Ogden Junior High School
### Climate Controlled
### Dry Bulb Temperature

| Class/Per. | A/NA | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/2 (S) | A | -.068 | 248 | NS | | 71-73 |
| Social/2 (S) | NA | .006 | 360 | NS | | 71-73 |
| Spanish/5 (W) | A | .083 | 367 | NS | | 71-74 |
| Spanish/5 (W) | NA | .066 | 333 | NS | | 71-74 |
| Social/7 | A | -.035 | 338 | NS | | 71-73 |
| Social/7 | NA | -.018 | 265 | NS | | 71-73 |
| Spanish/7 | A | .006 | 156 | NS | | 71-73 |
| Spanish/7 | NA | .069 | 199 | NS | | 71-73 |

### Phase I
### Ogden Junior High School
### Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/2 (S) | F | -.032 | 316 | NS | | 64.5-68 |
| Social/2 (S) | M | -.008 | 297 | NS | | 64.5-68 |
| Social/3 (R) | F | .222 | 49 | NS | | 65-68 |
| Social/3 (R) | M | -.012 | 148 | NS | | 65-68 |
| Social/6 (S) | F | .010 | 378 | NS | | 64-67.5 |
| Social/6 (S) | M | .066 | 191 | NS | | 64-67.5 |
| Social/7 (S) | F | -.061 | 405 | NS | | 64-68 |
| Social/7 (S) | M | -.086 | 220 | NS | | 64-68 |
| Social/7 (R) | F | .031 | 420 | NS | | 65-68 |
| Social/7 (R) | M | .206 | 107 | .05 | 66.94 | 65-68 |
| Spanish/7 (W) | F | .088 | 140 | NS | | 65-68 |
| Spanish/7 (W) | M | .017 | 219 | NS | | 65-68 |
| All Period 7 Combined | F | .021 | 969 | NS | | 64-68 |
| | M | .036 | 550 | NS | | 64-68 |
| | A/NA | | | | | |
| Social/2 (S) | A | -.046 | 248 | NS | | 64.5-68 |
| Social/2 (S) | NA | .005 | 360 | NS | | 64.5-68 |
| Spanish/5 (W) | A | .113 | 367 | .05 | 66.94 | 65-69 |
| Spanish/5 (W) | NA | .096 | 333 | NS | | 65-69 |
| Social/7 (S) | A | -.050 | 338 | NS | | 64-68 |
| Social/7 (S) | NA | -.052 | 265 | NS | | 64-68 |
| Spanish/7 (W) | A | .013 | 156 | NS | | 65-68 |
| Spanish/7 (W) | NA | .042 | 199 | NS | | 65-68 |

## Phase II
## Ogden Junior High School
## Climate Controlled
## Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/5 (R) | F | .039 | 270 | NS | | 74-76 |
| Social/5 (R) | M | -.009 | 213 | NS | | 74-76 |
| Social/5 (S) | F | .034 | 166 | NS | | 74-76 |
| Social/5 (S) | M | -.135 | 229 | .05 | 74.82 | 74-76 |
| Spanish/5 (W) | F | -.132 | 87 | NS | | 74-75 |
| Spanish/5 (W) | M | -.035 | 141 | NS | | 74-75 |
| Social/6 (R) | F | -.052 | 113 | NS | | 74-76 |
| Social/6 (R) | M | .023 | 257 | NS | | 74-76 |
| Spanish/6 (W) | F | .101 | 255 | NS | | 74-75 |
| Spanish/6 (W) | M | .054 | 145 | NS | | 74-75 |
| Social/6 (S) | F | -.002 | 127 | NS | | 74-76 |
| Social/6 (S) | M | -.125 | 218 | NS | | 74-76 |
| All Teachers | | .211 | 202 | .01 | 74.50 | 73-76 |
| | A/NA | | | | | |
| Social/5 (R) | A | -.016 | 91 | NS | | 74-76 |
| Social/5 (R) | NA | .016 | 343 | NS | | 74-76 |
| Social/5 (S) | A | -.135 | 110 | NS | | 74-76 |
| Social/5 (S) | NA | -.023 | 285 | NS | | 74-76 |

### Phase II
### Ogden Junior High School
### Climate Controlled
### Efective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Social/1 (R) | F | .037 | 301 | N.S. | | 66.5-69 |
| Social/1 (R) | M | -.121 | 209 | N.S. | | 66.5-69 |
| Social/2 (S) | F | -.005 | 212 | N.S. | | 66-70 |
| Social/2 (S) | M | -.075 | 246 | N.S. | | 66-70 |
| Social/5 (R) | F | -.155 | 220 | .05 | 68.67 | 67-70 |
| Social/5 (R) | M | -.069 | 213 | N.S. | | 67-70 |
| Social/5 (S) | F | .023 | 166 | N.S. | | 66-70 |
| Social/5 (S) | M | -.193 | 232 | .05 | 68.69 | 66-70 |
| Spanish/5 (W) | F | .029 | 86 | N.S. | | 66.5-69 |
| Spanish/5 (W) | M | -.041 | 138 | N.S. | | 66.5-69 |
| All Period 5 Combined | F | -.031 | 468 | N.S. | | 66-70 |
| | M | -.117 | 587 | .05 | 68.58 | 66-70 |
| Social/6 (R) | F | .024 | 112 | N.S. | | 66.5-70 |
| Social/6 (R) | M | -.032 | 288 | N.S. | | 66.5-70 |
| Social/6 (S) | F | -.019 | 126 | N.S. | | 67.5-70 |
| Social/6 (S) | M | -.115 | 213 | N.S. | | 67.5-70 |
| Spanish/6 (W) | F | .088 | 255 | N.S. | | 67-70 |
| Spanish/6 (W) | M | -.055 | 145 | N.S. | | 67-70 |
| All Period 6 Combined | F | .127 | 497 | .01 | 68.64 | 66.5-70 |
| | M | -.060 | 650 | N.S. | | 66.5-70 |
| All Periods | Teachers | .175 | 201 | .05 | 68.47 | 66-70 |
| | A/NA | | | | | |
| Social/5 (R) | A | -.011 | 91 | NS | | 67-70 |
| Social/5 (R) | NA | -.138 | 343 | .05 | 68.64 | 67-70 |
| Social/5 (S) | A | -.203 | 110 | .05 | 68.75 | 66-70 |
| Social/5 (S) | NA | -.023 | 285 | NS | | 66-70 |

**Phase I**
**Rex Putnam High School**
**Climate Controlled**
**Dry Bulb Temperature**

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Gen. Math/1 | F | .162 | 253 | .05 | 72.01 | 70-74 |
| Gen. Math/1 | M | .189 | 491 | .01 | 71.93 | 70-74 |
| Latin/1 | F | .321 | 206 | .01 | 74.12 | 69-75 |
| Latin/1 | M | .485 | 247 | .01 | 73.98 | 69-75 |
| Geom. /6 | F | .477 | 122 | .01 | 74.60 | 72-78 |
| Geom. /6 | M | .359 | 232 | .01 | 74.20 | 72-78 |
| All Teachers | | .523 | 154 | .01 | 73.92 | 69-80 |
| | A/NA | | | | | |
| Gen. Math/3 | A | .135 | 216 | .05 | 72.56 | 70-76 |
| Gen. Math/3 | NA | .148 | 524 | .01 | 72.58 | 70-76 |
| Geom. /6 | A | .378 | 98 | .01 | 74.16 | 72-78 |
| Geom. /6 | NA | .373 | 254 | .01 | 74.35 | 72-78 |

### Phase I
### Rex Putnam High School
### Climate Controlled
### Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 ($^{o}$F) Temp. | Range $^{o}$F |
|---|---|---|---|---|---|---|
| Gen. Math/1 | F | .155 | 253 | .05 | 65.92 | 64-67.5 |
| Gen. Math/1 | M | .181 | 491 | .01 | 65.80 | 64-67.5 |
| Latin/1 | F | .259 | 206 | .01 | 67.28 | 64-69 |
| Latin/1 | M | .406 | 247 | .01 | 67.15 | 64-69 |
| Gen. Math/3 | F | .161 | 409 | .01 | 66.49 | 64-69 |
| Gen. Math/3 | M | .080 | 320 | NS | | 64-69 |
| Geom. /6 | F | .438 | 122 | .01 | 67.95 | 65-71.5 |
| Geom. /6 | M | .326 | 232 | .01 | 67.54 | 65-71.5 |
| Geom. /7 | F | .583 | 196 | .01 | 68.20 | 66-73 |
| Geom. /7 | M | .539 | 246 | .01 | 68.19 | 66-73 |
| Geom. /9 | F | .411 | 263 | .01 | 68.43 | 65-72 |
| Geom. /9 | M | .442 | 221 | .01 | 68.39 | 65-72 |
| Latin/8 | F | .480 | 118 | .01 | 68.89 | 66-71.5 |
| Latin/8 | M | .154 | 63 | NS | | 66-71.5 |
| All Teachers | | .509 | 154 | .01 | 67.38 | 64-73 |
| | A/NA | | | | | |
| Gen. Math/3 | A | .095 | 216 | NS | | 64-69 |
| Gen. Math/3 | NA | .105 | 524 | .05 | 66.44 | 64-69 |
| Geom. /6 | A | .380 | 98 | .01 | 67.57 | 65-71.5 |
| Geom. /6 | NA | .305 | 254 | .01 | 67.82 | 65-71.5 |

# Phase II
# Rex Putnam High School
# Climate Controlled
# Dry Bulb Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Latin/1-3 | F | .054 | 110 | NS | | 72-73 |
| Latin/1-3 | M | -.089 | 167 | NS | | 72-73 |
| Math/22-24 | F | .192 | 79 | NS | | 72-74 |
| Math/22-24 | M | -.015 | 346 | NS | | 72-74 |
| Geom. /22-24 | F | .088 | 152 | NS | | 72-76 |
| Geom. /22-24 | M | .122 | 393 | .05 | 73.64 | 72-76 |
| Geom. /25-27 | F | .209 | 279 | .01 | 73.63 | 72-76 |
| Geom. /25-27 | M | .139 | 255 | .05 | 73.54 | 72-76 |
| Math/25-27 | F | .041 | 205 | NS | | 73-74 |
| Math/25-27 | M | .028 | 209 | NS | | 73-74 |
| Latin/25-27 | F | -.055 | 192 | NS | | 70-72 |
| Latin/25-27 | M | .069 | 98 | NS | | 70-72 |
| Comb. /25-27 | F | .328 | 680 | .01 | 72.88 | 70-76 |
| Comb. /25-27 | M | .147 | 566 | .01 | 72.98 | 70-76 |
| All Teachers | | .268 | 129 | .01 | 72.63 | 70-76 |
| | A/NA | | | | | |
| Geom. /22-24 | A | .149 | 203 | .05 | 73.61 | 72-76 |
| Geom. /22-24 | NA | .092 | 342 | NS | | 72-76 |
| Geom. /25-27 | A | .149 | 117 | NS | | 72-76 |
| Geom. /25-27 | NA | .183 | 420 | .01 | 73.56 | 72-76 |

## Phase II
## Rex Putnam High School
## Climate Controlled
## Effective Temperature

| Class/Per. | Sex | r | df | P<. | #4 (°F) Temp. | Range °F |
|---|---|---|---|---|---|---|
| Latin/1-3 | F | .191 | 110 | N.S. | | 63.5-68 |
| Latin/1-3 | M | .005 | 168 | N.S. | | 63.5-68 |
| Latin/10-12 | F | .108 | 88 | N.S. | | 63.5-68 |
| Latin/10-12 | M | -.044 | 192 | N.S. | | 63.5-68 |
| Latin/25-27 | F | .058 | 192 | N.S. | | 63-67 |
| Latin/25-27 | M | -.088 | 97 | N.S. | | 63-67 |
| Latin/Combined | F | .141 | 394 | .01 | 66.08 | 63-68 |
| Latin/Combined | M | -.062 | 461 | N.S. | | 63-68 |
| Geom./22-24 (E) | F | .130 | 152 | N.S. | | 65-70 |
| Geom./22-24 (E) | M | .029 | 393 | N.S. | | 65-70 |
| Geom./25-27 | F | .188 | 279 | .01 | 67.66 | 64-70 |
| Geom./25-27 | M | .034 | 255 | N.S. | | 64-70 |
| Geom./Combined | F | .172 | 433 | .01 | 67.66 | 64-70 |
| Geom./Combined | M | .038 | 650 | N.S. | | 64-70 |
| Math/22-24 (P) | F | .125 | 79 | N.S. | | 65-69 |
| Math/22-24 (P) | M | .002 | 346 | N.S. | | 65-69 |
| Math/25-27 | F | .106 | 205 | N.S. | | 65-69 |
| Math/25-27 | M | -.062 | 210 | N.S. | | 65-69 |
| Math/Combined | F | .127 | 286 | .05 | 67.34 | 65-69 |
| Math/Combined | M | .002 | 558 | N.S. | | 65-69 |
| Period 22-24 | F | .064 | 233 | N.S. | | 65-70 |
| Combined | M | .026 | 741 | N.S. | | 65-70 |
| Period 25-27 | F | .292 | 680 | .01 | 67.05 | 63-70 |
| Combined | M | .032 | 566 | N.S. | | 63-70 |
| All Periods | Teachers | .276 | 129 | .01 | 66.64 | 63-70 |
| | A/NA | | | | | |
| Geom./22-24 | A | .097 | 203 | NS | | 65-70 |
| Geom./22-24 | NA | .047 | 342 | NS | | 65-70 |
| Geom./25-27 | A | .137 | 117 | NS | | 64-70 |
| Geom./25-27 | NA | .104 | 420 | .05 | 67.62 | 64-70 |

# APPENDIX III

## Predicted "Neutral" Temperatures and Regression Equations for Significant Correlations of Thermal Comfort and Classroom Temperature

| | |
|---|---|
| Phase I | Dry Bulb Air Temperature<br>Effective Temperature |
| Phase II | Dry Bulb Air Temperature<br>Effective Temperature |

## Phase I
## Predicted "Neutral" Temperatures and Regression Equations for Significant Correlations of Thermal Comfort and Dry Bulb Temperature

| Non-Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| East Gresham Grade | Period 5/Comb. | F | X=.833(4-4.79)+73.14 | 72.48 | 67-81 |
| | Period 5/Comb. | M | X=.726(4-4.98)+73.24 | 72.53 | 67-81 |
| | All Teachers | | X=1.608(4-4.47)+73.18 | 72.42 | 67-81 |
| Gardiner Junior High | Spanish/1 (W) | M | X=.199(4-4.99)+73.76 | 73.56 | 69-77 |
| | Social/1 (B) | F | X=.368(4-3.609)+72.964 | 73.11 | 70-76 |
| | Period 1/Comb. | F | X=.265(4-4.06)+73.18 | 73.16 | 69-77 |
| | Period 1/Comb. | M | X=.180(4-4.69)+73.24 | 73.12 | 69-77 |
| | Social/7 (A) | F | X=.694(4-5.26)+76.96 | 76.09 | 74-81 |
| | Social/7 (A) | M | X=.678(4-4.98)+76.98 | 76.32 | 74-81 |
| | All Teachers | | X=1.507(4-4.41)+75.204 | 74.59 | 69-81 |
| Milwaukie High | Latin III/1 (S) | F | X=1.108(4-3.5)+72.42 | 72.97 | 68-76 |
| | Latin III/1 (S) | M | X=1.014(4-3.49)+72.20 | 72.72 | 68-76 |
| | Geom./1 (W) | F | X=.676(4-4.37)+75.70 | 75.45 | 69-81 |
| | Geom./1 (W) | M | X=.819(4-4.29)+75.57 | 75.33 | 69-81 |
| | Period 1/Comb. | F | X=.779(4-4.57)+76.28 | 75.84 | 68-85 |
| | Period 1/Comb. | M | X=1.102(4-4.22)+75.61 | 75.37 | 68-85 |
| | Latin I/5 | F | X=1.816(4-4.51)+78.426 | 77.50 | 72-85 |
| | Latin I/5 | M | X=2.341(4-4.816)+78.356 | 76.45 | 72.85 |
| | Geom./5 | F | X=1.717(4-4.84)+79.78 | 78.34 | 75-86 |
| | Geom./5 | M | X=2.187(4-4.616)+79.745 | 78.40 | 75-86 |
| | Gen. Math/5 | F | X=.715(4-5.84)+80.47 | 79.15 | 74-86 |
| | Gen. Math/5 | M | X=1.411(4-5.57)+79.81 | 77.60 | 74-86 |
| | Period 5/Comb. | F | X=1.608(4-4.83)+79.50 | 78.17 | 72-86 |
| | Period 5/Comb. | M | X=1.824(4-4.91)+79.35 | 77.69 | 72-86 |

| Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| Powell Valley Grade | All Teachers | | X=-.368(4-3.89)+74.04 | 74.00 | 73-76 |
| Rex Putnam High | Latin/1 | F | X=.443(4-4.43)+74.31 | 74.12 | 69-75 |
| | Latin/1 | M | X=.802(4-4.37)+74.28 | 73.98 | 69-75 |
| | Gen. Math/1 (R) | F | X=.160(4-3.74)+71.97 | 72.01 | 70-74 |
| | Gen. Math/1 (R) | M | X=.185(4-4.19)+71.96 | 71.93 | 70-74 |
| | Geom. /6 | F | X=.747(4-3.92)+74.54 | 74.60 | 72-78 |
| | Geom. /6 | M | X=.416(4-4.73)+74.50 | 74.20 | 72-78 |
| | All Teachers | | X=.959(4-4.36)+74.26 | 73.92 | 69-80 |

## Phase I
## Predicted "Neutral" Temperatures and Regression Equations for Significant Correlations of Thermal Comfort and Effective Temperature

| Non-Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| East Gresham Grade | Period 5/Comb. | F | X=.569(4-4.79)+66.80 | 66.35 | 60-73 |
| | Period 5/Comb. | M | X=.511(4-5.00)+66.855 | 66.34 | 60-73 |
| | All Teachers | | X=.941(4-4.49)+66.79 | 66.33 | 60-73 |
| Gardiner Junior High | Period 1/Comb. | F | X=.461(4-4.08)+67.25 | 67.21 | 60-73 |
| | Spanish/3 (W) | F | X=.207(4-4.73)+69.32 | 69.17 | 65.5-72 |
| | Spanish/3 (W) | M | X=.256(4-4.646)+69.28 | 69.12 | 65.5-72 |
| | Social/6 (B) | F | X=.259(4-5.03)+70.245 | 69.98 | 68-74 |
| | Social/7 (A) | F | X=.225(4-5.3)+69.42 | 69.13 | 66-74 |
| | Social/7 (A) | M | X=.525(4-5.00)+69.42 | 68.90 | 66-74 |
| | All Teachers | | X=1.179(4-4.4)+68.33 | 67.86 | 63-74 |
| Milwaukie High | Latin III/1 | F | X=.387(4-3.5)+66.00 | 66.19 | 63-70 |
| | Latin III/1 | M | X=.425(4-3.49)+65.91 | 66.13 | 63-70 |
| | Geom./1 | F | X=.381(4-4.42)+68.72 | 68.56 | 63-73 |
| | Geom./1 | M | X=.345(4-4.29)+68.67 | 68.57 | 63-73 |
| | F.Math/1 | M | X=.522(4-4.60)+69.58 | 69.27 | 64-75 |
| | Period 1/Comb. | F | X=.357(4-4.59)+68.88 | 68.67 | 63-75 |
| | Period 1/Comb. | M | X=.714(4-4.23)+68.40 | 68.24 | 63-75 |
| | Latin I/5 | F | X=1.273(4-4.51)+70.407 | 69.76 | 66-75 |
| | Latin I/5 | M | X=1.601(4-4.816)+70.43 | 69.12 | 66-75 |
| | Geom./5 | F | X=1.173(4-4.84)+71.535 | 70.55 | 68-76 |
| | Geom./5 | M | X=1.537(4-4.616)+71.48 | 70.53 | 68-76 |
| | Gen. Math/5 | F | X=.568(4-5.84)+71.593 | 70.55 | 67-75 |
| | Gen. Math/5 | M | X=1.040(4-5.57)+71.07 | 69.44 | 67-75 |
| | Period 5/Comb. | F | X=1.105(4-4.83)+71.27 | 70.35 | 66-76 |
| | Period 5/Comb. | M | X=1.232(4-4.91)+71.075 | 69.95 | 66-76 |
| | All Teachers | | X=1.2.2(4-4.56(+69.785 | 69.11 | 63-79 |

| Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| Powell Valley Grade | All Teachers |  | X=-.614(4-3.89)+67.075 | 67.01 | 66-69 |
| Ogden Junior High | Social/7 (R) | M | X=.236(4-4.38)+67.032 | 66.94 | 65-68 |
| Rex Putnam High | Latin/1 | F | X=.289(4-4.44)+67.41 | 67.28 | 64-69 |
|  | Latin/1 | M | X=.536(4-4.37)+67.35 | 67.15 | 64-69 |
|  | Gen. Math/1 | F | X=.157(4-3.74)+65.88 | 65.92 | 64-67.5 |
|  | Gen. Math/1 | M | X=.188(4-4.20)+65.84 | 65.80 | 64-67.5 |
|  | Gen. Math/3 | F | X=.200(4-3.87)+66.46 | 66.49 | 64-69 |
|  | Geom. /6 | F | X=.576(4-4.073)+67.988 | 67.95 | 65-71.5 |
|  | Geom. /6 | M | X=.354(4-4.94)+67.87 | 67.54 | 65-71.5 |
|  | Geom. /7 | F | X=.455(4-4.13)+68.26 | 68.20 | 66-73 |
|  | Geom. /7 | M | X=.425(4-4.25)+68.30 | 68.19 | 66-73 |
|  | Latin/8 | F | X=.428(4-3.65)+68.741 | 68.89 | 66-71.5 |
|  | Geom. /9 | F | X=.249(4-4.238)+68.485 | 68.43 | 65-72 |
|  | Geom. /9 | M | X=.334(4-4.372)+68.515 | 68.39 | 65-72 |
|  | All Teachers |  | X=.777(4-4.33)+67.64 | 67.38 | 64-73 |

## Phase II
## Predicted "Neutral" Temperatures and Regression Equations for Significant Correlations of Thermal Comfort and Dry Bulb Temperature

| Non-Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (S) | F | $X=.409(4-4.48)+71.4$ | 71.20 | 66-75 |
| | Spelling/5 (S) | M | $X=.196(4-4.93)+71.34$ | 71.16 | 66-75 |
| | Spelling/5 (C) | M | $X=.312(4-5.524)+72.37$ | 71.90 | 68-76 |
| | Period 5/Comb. | F | $X=.281(4-5.004)+71.72$ | 71.44 | 66-76 |
| | Period 5/Comb. | M | $X=.234(4-5.43)+71.76$ | 71.43 | 66-76 |
| | Teachers/5 | | $X=1.197(4-4.18)+71.78$ | 71.57 | 66-76 |
| Gardiner Junior High | Spanish/1 (W) | F | $X=.872(4-4.22)+73.93$ | 73.74 | 70-77 |
| | Social/1 (B) | F | $X=.762(4-4.50)+71.13$ | 70.75 | 62-74 |
| | Social/1 (B) | M | $X=.567(4-4.38)+70.91$ | 70.70 | 62-74 |
| | Period 1/Comb. | F | $X=.399(4-4.374)+70.71$ | 70.56 | 62-77 |
| | Period 1/Comb. | M | $X=.222(4-4.55)+70.71$ | 70.59 | 62-77 |
| | Social/2 (A) | F | $X=.355(4-4.74)+71.73$ | 71.47 | 68-74 |
| | Period 2/Comb. | M | $X=.247(4-4.49)+72.83$ | 72.71 | 68-78 |
| | Spanish/3 (W) | F | $X=.673(4-5.31)+74.73$ | 73.85 | 68-80 |
| | Spanish/3 (W) | M | $X=.451(4-4.84)+74.815$ | 74.44 | 68-80 |
| | All Teachers | | $X=.825(4-4.52)+73.11$ | 72.68 | 62-80 |
| Milwaukie High | Latin I/1 (S) | F | $X=.370(4-3.82)+70.83$ | 70.90 | 66-73 |
| | Latin I/1 (S) | M | $X=.594(4-3.97)+70.77$ | 70.79 | 66-73 |
| | Gen. Math/1 (W) | F | $X=.381(4-4.66)+74.84$ | 74.59 | 72-78 |
| | Gen. Math/1 (W) | M | $X=.315(4-4.34)+74.86$ | 74.75 | 72-78 |
| | Period 1/Comb. | F | $X=.607(4-4.33)+73.43$ | 73.23 | 66-78 |
| | Period 1/Comb. | M | $X=.430(4-4.18)+73.58$ | 73.50 | 66-78 |
| | Period 4/Comb. | M | $X=.192(4-4.76)+75.10$ | 74.95 | 72-78 |
| | Geom. /7 (W) | F | $X=.799(4-4.56)+76.18$ | 75.73 | 72-79 |
| | Geom. /7 (W) | M | $X=.577(4-3.36)+76.39$ | 76.76 | 72-79 |
| | Gen. Math/7 (W) | F | $X=.558(4-5.03)+75.96$ | 75.39 | 71-80 |
| | Gen. Math/7 (W) | M | $X=.515(4-4.99)+76.18$ | 75.67 | 71-80 |
| | Period 7/Comb. | F | $X=.621(4-4.78)+76.08$ | 75.60 | 71-80 |
| | Period 7/Comb. | M | $X=.521(4-4.81)+76.29$ | 75.87 | 71-80 |

| Climate Controlled School | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| Ogden Junior High | Social/5 (S) | M | $X=-.062(4-4.25)+74.80$ | 74.82 | 74-76 |
| | All Teachers | | $X=.368(4-4.03)+74.51$ | 74.50 | 73-76 |
| Rex Putnam High | Geom. /22-24 | M | $X=.128(4-4.50)+73.70$ | 73.64 | 72-76 |
| | Geom. /25-27 | F | $X=.180(4-4.24)+73.67$ | 73.63 | 72-76 |
| | Geom. /25-27 | M | $X=.121(4-4.50)+73.60$ | 73.54 | 72-76 |
| | Mod. 25-27/Comb. | F | $X=.314(4-3.77)+72.81$ | 72.88 | 70-76 |
| | Mod. 25-27/Comb. | M | $X=.135(4-4.32)+73.02$ | 72.98 | 70-76 |
| | All Teachers | | $X=.344(4-4.52)+72.81$ | 72.63 | 70-76 |

### Phase II

### Predicted "Neutral" Temperatures and Regression Equations for Significant Correlations of Thermal Comfort and Effective Temperature

| Non-Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (S) | F | X=.575(4-4.46)+66.14 | 65.88 | 60-70 |
| | Spelling/5 (S) | M | X=.261(4-4.93)+66.05 | 65.81 | 60-70 |
| | Spelling/5 (C) | M | X=.350(4-5.524)+66.998 | 66.47 | 63-71 |
| | Period 5/Comb. | F | X=.449(4-4.998)+66.275 | 65.83 | 60-71 |
| | Period 5/Comb. | M | X=.267(4-5.425)+66.315 | 65.94 | 60-71 |
| | Teachers/5 | | X=1.398(4-4.15)+66.36 | 66.15 | 60-71 |
| Gardiner Junior High | Spanish/1 (W) | F | X=.783(4-4.279)+66.625 | 66.41 | 62-70 |
| | Social/1 (B) | F | X=.828(4-4.50)+65.25 | 64.84 | 56-69 |
| | Social/1 (B) | M | X=.602(4-4.38)+65.18 | 64.95 | 56-69 |
| | Period 1/Comb. | F | X=.451(4-4.39)+64.815 | 64.64 | 56-70 |
| | Period 1/Comb. | M | X=.212(4-4.57)+64.83 | 64.71 | 56-70 |
| | Social/2 (A) | F | X=.452(4-4.74)+65.735 | 65.40 | 61-69 |
| | Period 2/Comb. | M | X=.201(4-4.49)+66.71 | 66.61 | 61-72 |
| | Spanish/3 (W) | F | X=.404(4-5.31)+67.79 | 67.26 | 63-72 |
| | Spanish/3 (W) | M | X=.325(4-4.83)+67.80 | 67.53 | 63-72 |
| | Social/7 (A) | M | X=-.281(4-4.748)+68.145 | 68.36 | 64-71 |
| | All Teachers | | X=.906(4-4.52)+66.565 | 66.09 | 56-72 |
| Milwaukie High | Latin/1 | F | X=.230(4-3.79)+65.06 | 65.11 | 61.5-66.5 |
| | Latin/1 | M | X=.579(4-4.00)+65.11 | 65.11 | 61.5-66.5 |
| | Geom./1 | F | X=.183(4-4.38)+67.35 | 67.28 | 62.5-70 |
| | Gen. Math/1 | F | X=.185(4-4.66)+68.18 | 68.06 | 66-70.5 |
| | Gen. Math/1 | M | X=.192(4-4.35)+68.24 | 68.17 | 66-70.5 |
| | Period 1/Comb. | F | X=.450(4-4.32)+67.04 | 66.90 | 61.5-70.5 |
| | Period 1/Comb. | M | X=.384(4-4.19)+67.14 | 67.07 | 61.5-70.5 |
| | Period 4/Comb. | F | X=.183(4-4.11)+68.13 | 68.11 | 65-70 |
| | Geom./7 | F | X=.877(4-4.56)+68.77 | 68.28 | 65-72 |
| | Geom./7 | M | X=.614(4-4.64)+68.995 | 68.60 | 65-72 |
| | Gen. Math/7 | F | X=.308(4-5.03)+68.98 | 68.66 | 66-72 |
| | Gen. Math/7 | M | X=.254(4-4.988)+69.14 | 68.89 | 66-72 |
| | Period 7/Comb. | F | X=.549(4-4.78)+68.86 | 68.43 | 65-72 |
| | Period 7/Comb. | M | X=.377(4-4.806)+69.065 | 68.76 | 65-72 |
| | All Teachers | | X=.362(4-5.15)+68.018 | 67.60 | 61.5-72 |

| Climate Controlled Schools | Class/Per. | Sex | Regression Equation | #4 Temp. °F | Range °F |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (N) | F | X=-.141(4-3.82)+68.195 | 68.17 | 66.5-70 |
| Ogden Junior High | Social/5 (R) | F | X=-.098(4-4.649)+68.61 | 68.67 | 67-70 |
| | Social/5 (S) | M | X=-.196(4-4.28)+68.635 | 68.69 | 66-70 |
| | Period 5/Comb. | M | X=-.104(4-4.28)+68.547 | 68.58 | 66-70 |
| | Period 6/Comb. | F | X=.097(4-3.95)+68.63 | 68.64 | 66.5-70 |
| | All Teachers | | X=.495(4-4.03)+68.488 | 68.47 | 66-70 |
| Rex Putnam High | Latin/Comb. | F | X=.129(4-3.20)+65.98 | 66.08 | 63-68 |
| | Geom./25-27 | F | X=.228(4-4.24)+67.71 | 67.66 | 64-70 |
| | Geom./Comb. | F | X=.228(4-4.294)+67.73 | 67.66 | 64-70 |
| | Math/Comb. | F | X=.117(4-4.06)+67.345 | 67.34 | 65-69 |
| | Mod. 25-27/Comb. | F | X=.332(4-3.77)+66.975 | 67.05 | 63-70 |
| | All Teachers | | X=.481(4-4.52)+66.89 | 66.64 | 63-70 |

# APPENDIX IV

## Results of Analyses of Teachers' Class Behavior Ratings by Effective Temperature Phase I and Phase II

## Phase I

## CLASS BEHAVIOR RATINGS X EFFECTIVE TEMPERATURE

### Climate Controlled

#### Powell Valley Grade School

No Significant Relationship

#### Ogden Junior High School

No Significant Relationship

#### Rex Putnam High School

1:3 teachers significant
P<.001

| Ratings | <68° | > 67° |
|---|---|---|
| 5< | 18 | 68 |
| 6> | 13 | 2 |

$X^2 = 25.95$

### Non-Climate Controlled

#### East Gresham Grade School

1:3 teachers significant
P<.05

| Ratings | <69° | > 68° |
|---|---|---|
| 3< | 10 | 6 |
| 4 | 2 | 3 |
| 5> | 17 | 2 |

$X^2 = 6.20$

#### Gardiner Junior High School

3:3 teachers significant
P<.001, .01, .05
Combined significant:
P<.001

| Ratings | <69° | > 68° |
|---|---|---|
| 4< | 21 | 30 |
| 5 | 112 | 96 |
| 6> | 79 | 29 |

$X^2 = 17.16$

#### Milwaukie High School

2:3 teachers significant
P<.001, 1 teacher P<.001

| Ratings | <69° | > 68° |
|---|---|---|
| 4< | 10 | 69 |
| 5 | 39 | 59 |
| 6> | 62 | 58 |

$X^2 = 31.49$

| Ratings | <71° | > 70° |
|---|---|---|
| 4< | 0 | 30 |
| 5 | 16 | 13 |
| 6> | 14 | 32 |

$X^2 = 29.58$

## Phase II

## CLASS BEHAVIOR RATINGS X EFFECTIVE TEMPERATURE

### Climate Controlled

**Powell Valley Grade School**

No significant relationship

**Ogden Junior High School**

1:3 teachers significant
$P < .02$

| Ratings | < 69° | > 68° |
|---|---|---|
| 5 < | 23 | 21 |
| 6 > | 1 | 11 |

$X^2 = 5.75$

**Rex Putnam High School**

No significant relationship

### Non-Climate Controlled

**East Gresham Grade School**

No significant relationship

**Gardiner Junior High School**

1:3 teachers significant
$P < .001$

| Ratings | < 66° | > 65° |
|---|---|---|
| 5 < | 17 | 62 |
| 6 > | 12 | 1 |

$X^2 = 22.74$

**Milwaukie High School**

3:3 teachers significant
$P < .05 \quad < .01, \; < .05$

| Ratings | < 69° | > 68° |
|---|---|---|
| 5 < | 3 | 14 |
| 6 | 23 | 34 |
| 7 > | 11 | 7 |

$X^2 = 6.87$

| Ratings | < 69° | > 68° |
|---|---|---|
| 4 < | 7 | 21 |
| 5 | 15 | 20 |
| 6 > | 17 | 7 |

$X^2 = 11.07$

| Ratings | < 69° | > 68° |
|---|---|---|
| 6 < | 5 | 3 |
| 7 > | 4 | 25 |

$X^2 = 5.65$

# APPENDIX V

## Results of Correlations between Test Performance Measures and Classroom Temperatures

| | |
|---|---|
| Phase I | Dry Bulb Air Temperature<br>Effective Temperature |
| Phase II | Dry Bulb Air Temperature<br>Effective Temperature |

## Phase I
## Test Scores vs. Dry Bulb Temperature
## Non-Climate Controlled Schools

| School | Class/Per. | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (C) | -.125 | 224 | NS | 67-70 |
| | Spelling/5 (H) | -.123 | 217 | NS | 71-80 |
| | Spelling/5 (S) | -.259 | 204 | .01 | 68-81 |
| | All Period 5 Combined | -.171 | 649 | .01 | 67-81 |
| Gardiner Junior High | Spanish/1 (W) | -.312 | 177 | .01 | 69-77 |
| | Spanish/2 (W) | -.276 | 130 | .01 | 71-77 |
| | Spanish/3 (W) | .082 | 186 | NS | 73-79 |
| | Spanish/Comb. | -.117 | 497 | .01 | 69-79 |
| | Social/2 (A) | .197 | 244 | .01 | 72-76 |
| | Social/6 (B) | -.273 | 252 | .01 | 76-80 |
| | Social/Comb. | -.004 | 498 | NS | 72-80 |
| Milwaukie High | Latin III/1 | -.120 | 71 | NS | 70-76 |
| | Latin I/3 | -.124 | 108 | NS | 72-80 |
| | Latin II/4 | -.074 | 111 | NS | 72-84 |
| | Latin I/5 | -.173 | 102 | NS | 72-84 |
| | Latin/Comb. | -.105 | 399 | .05 | 70-84 |
| | Geom. /1 | -.080 | 226 | NS | 72-81 |
| | Geom. /5 | -.466 | 218 | .01 | 77-85 |
| | Geom. /Comb. | -.230 | 457 | .01 | 72-85 |
| | F. Math/1 | -.084 | 225 | NS | 74-85 |
| | F. Math/6 | -.035 | 201 | NS | 76-83 |
| | F. Math/Comb. | -.064 | 428 | NS | 74-85 |

## Phase I
## Test Scores vs. Dry Bulb Temperature
## Climate Controlled Schools

| School | Class/Per. | r | df | P< . | Range(°F) |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (Nl) | .063 | 183 | NS | 74-76 |
| | Spelling/5 (N) | .267 | 190 | .01 | 73-74 |
| | Spelling/5 (S) | .258 | 169 | .01 | 74-75 |
| | All Period 5 Combined | .090 | 546 | .05 | 73-76 |
| Ogden Junior High | Spanish/5 (W) | .134 | 242 | .05 | 72-74 |
| | Spanish/6 (W) | -.062 | 103 | NS | 71-73 |
| | Spanish/7 (W) | -.254 | 86 | .05 | 71-73 |
| | Spanish/Comb. | -.025 | 435 | NS | 71-74 |
| | Social/2 (S) | -.212 | 237 | .01 | 71-73 |
| | Social/7 (R) | -.240 | 210 | .01 | 72-73 |
| | Social/Comb. | -.183 | 449 | .01 | 71-73 |
| Rex Putnam High | Latin III/1 | .349 | 194 | .01 | 73-75 |
| | Latin/8 | .414 | 78 | .01 | 71-77 |
| | Latin/Comb. | .308 | 274 | .01 | 71-77 |
| | Geom. /6 | .015 | 115 | NS | 72-76 |
| | Geom. /7 | .054 | 139 | NS | 73-76 |
| | Geom. /9 | .064 | 161 | NS | 73-76 |
| | Geom. /Comb. | .049 | 419 | NS | 72-76 |
| | Gen. Math/1 (R) | .017 | 314 | NS | 70-73 |
| | Gen. Math/3 | .071 | 303 | NS | 71-75 |
| | Gen. Math/Comb. | .046 | 619 | NS | 70-75 |

## Phase I
## Test Scores vs. Effective Temperature
## Non-Climate Controlled Schools

| School | Class/Per. | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (C) | -.119 | 224 | NS | 62-71.5 |
| | Spelling/5 (H) | -.152 | 217 | .05 | 65.5-71 |
| | Spelling/5 (S) | -.290 | 204 | .01 | 62-73 |
| | All Period 5 Combined | -.195 | 649 | .01 | 62-73 |
| Gardiner Junior High | Spanish/1 (W) | -.294 | 177 | .01 | 63.5-71 |
| | Spanish/2 (W) | -.123 | 130 | NS | 65-70 |
| | Spanish/3 (W) | .028 | 186 | NS | 66.5-71.5 |
| | Spanish/Comb. | -.109 | 497 | .05 | 63.5-71.5 |
| | Social/2 (A) | -.193 | 244 | .01 | 65.5-70 |
| | Social/6 (B) | -.310 | 252 | .01 | 68.5-72.5 |
| | Social/Comb. | -.154 | 498 | .01 | 65.5-72.5 |
| Milwaukie High | Latin III/1 | -.174 | 71 | NS | 64-68.5 |
| | Latin I/3 | -.183 | 108 | NS | 65-72 |
| | Latin II/4 | -.083 | 111 | NS | 66-74 |
| | Latin I/5 | -.240 | 102 | .05 | 66-75 |
| | Latin/Comb. | -.145 | 399 | .01 | 64-75 |
| | Geom. /1 | -.059 | 236 | NS | 66-73 |
| | Geom. /5 | -.384 | 218 | .01 | 68.5-76 |
| | Geom. /Comb. | -.195 | 457 | .01 | 66-76 |
| | F. Math/1 | -.127 | 225 | NS | 67-74 |
| | F. Math/6 | .043 | 201 | NS | 67-74 |
| | F. Math/Comb. | -.055 | 428 | NS | 67-74 |

## Phase I
## Test Scores vs. Effective Temperature
## Climate Controlled Schools

| School | Class/Per. | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (N1) | .159 | 183 | .05 | 67-69 |
| | Spelling/5 (N) | .170 | 190 | .05 | 66-68 |
| | Spelling/5 (S) | .129 | 169 | NS | 66-67.5 |
| | All Period 5 Combined | .126 | 546 | .01 | 66-69 |
| Ogden Junior High | Spanish/5 (W) | -.086 | 242 | NS | 65.5-68.5 |
| | Spanish/6 (W) | .138 | 103 | NS | 64.5-67.5 |
| | Spanish/7 (W) | -.426 | 86 | .01 | 65-68 |
| | Spanish/Comb. | -.141 | 435 | .01 | 64.5-68.5 |
| | Social/2 (S) | -.424 | 237 | .01 | 64.5-67 |
| | Social/7 (R) | -.298 | 210 | .01 | 65-68 |
| | Social/Comb. | -.313 | 449 | .01 | 64.5-68 |
| Rex Putnam High | Latin III/1 | -.252 | 194 | .01 | 66.5-69 |
| | Latin/8 | .332 | 78 | .01 | 66-71.5 |
| | Latin/Comb. | .009 | 274 | NS | 66-71.5 |
| | Geom./6 | -.089 | 115 | NS | 65.5-70 |
| | Geom./7 | -.186 | 159 | .05 | 66-70 |
| | Geom./9 | -.066 | 161 | NS | 66-71 |
| | Geom./Comb. | -.104 | 419 | .05 | 65.5-71 |
| | Gen.Math/1 (R) | .039 | 314 | NS | 64-67.5 |
| | Gen.Math/3 | .133 | 303 | .05 | 65-69 |
| | Gen. Math/Comb. | .088 | 619 | .05 | 64-69 |

## Phase II
## Test Scores vs. Effective Temperature
## Non-Climate Controlled Schools

| School | Class/Per. | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (H) | .264 | 138 | .01 | 63-68 |
| | Spelling/5 (C) | -.138 | 140 | N.S. | 63-70 |
| | Spelling/5 (S) | .183 | 163 | .05 | 62-70 |
| | All Periods Combined | .066 | 448 | N.S. | 62-70 |
| Gardiner Junior High | Social/1 (A) | -.007 | 104 | N.S. | 63-68 |
| | Social/1 (B) | -.251 | 161 | .01 | 63-68 |
| | Spanish/1 (W) | .083 | 54 | N.S. | 64-69 |
| | Period 1 Combined | -.081 | 323 | N.S. | 63-69 |
| | Social/2 (A) | .155 | 139 | N.S. | 66-68 |
| | Social/2 (B) | .005 | 185 | N.S. | 63-71 |
| | Spanish/2 (W) | -.407 | 41 | .01 | 66-71 |
| | Period 2 Combined | .308 | 396 | N.S. | 63-71 |
| | Spanish/3 (W) | -.266 | 111 | .01 | 66-71 |
| Milwaukie High | Latin I/1 (S) | -.217 | 139 | .01 | 65-66.5 |
| | Gen. Math/1 (W) | .208 | 207 | .01 | 66-70 |
| | Geom. /1 (W) | .027 | 248 | N.S. | 65.5-68 |
| | Period 1 Combined | .040 | 598 | N.S. | 65-70 |
| | Latin III/4 (S) | .106 | 82 | N.S. | 66-69.5 |
| | Geom. /4 (W) | .138 | 263 | .05 | 66-70 |
| | Period 4 Combined | .131 | 347 | .05 | 66-70 |
| | Gen. Math/7 (W) | -.081 | 203 | N.S. | 66-72 |
| | Geom. /7 (W) | -.103 | 224 | N.S. | 65.5-70.5 |
| | Period 7 Combined | -.090 | 429 | N.S. | 65.5-72 |

### Phase II
### Test Scores vs. Effective Temperature
### Climate Controlled Schools

| School | Class/Per. | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (S) | -.194 | 189 | .01 | 67-70 |
| | Spelling/5 (J) | .140 | 189 | N.S. | 66-68 |
| | Spelling/5 (N) | .286 | 177 | .01 | 67-69 |
| | Period 5 Combined | .031 | 559 | N.S. | 66-70 |
| Ogden Junior High | Spanish/5 (W) | .069 | 73 | N.S. | 68-69 |
| | Social/5 (R) | .259 | 141 | .01 | 67.5-69.5 |
| | Social/5 (S) | -.036 | 117 | N.S. | 66-70 |
| | Period 5 Combined | .062 | 335 | N.S. | 66-70 |
| | Spanish/6 (W) | .093 | 121 | N.S. | 67.5-69 |
| | Social/6 (R) | -.053 | 136 | N.S. | 67.5-70 |
| | Social/6 (S) | -.005 | 113 | N.S. | 67.5-70 |
| | Period 6 Combined | -.010 | 374 | N.S. | 67.5-70 |
| | Spanish/7 (W) | -.094 | 106 | N.S. | 66.5-69 |
| Rex Putnam High | Latin/1-3 (M) | -.292 | 113 | .01 | 64-68 |
| | Latin/10-12 (M) | -.018 | 134 | N.S. | 63.5-67.5 |
| | Latin/25-27 (M) | -.286 | 122 | .01 | 64-67 |
| | Latin/Combined | -.215 | 373 | .01 | 63.5-68 |
| | Geom. /22-24(E) | .433 | 207 | .01 | 66-70 |
| | Geom. /25-27(E) | .471 | 201 | .01 | 66-70 |
| | Geom. /Combined | .448 | 412 | .01 | 66-70 |
| | Math/22-24 (P) | -.095 | 167 | N.S. | 65-68 |
| | Math/25-27 (P) | .083 | 159 | N.S. | 65-69 |
| | Math/Combined | -.009 | 328 | N.S. | 65-69 |
| | Combined/22-24 | .219 | 376 | .01 | 65-70 |
| | Combined/25-27 | .155 | 493 | .01 | 64-70 |

### Phase II
### Test Scores vs. Dry Bulb Temperature
### Non-Climate Controlled Schools

| School | Class | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| East Gresham Grade | All Period 5 Combined | .035 | 448 | NS | 68-75 |
| Gardiner Junior High | Spanish/Comb. | -.083 | 205 | NS | 70-79 |
| | Social/Comb. | -.029 | 877 | NS | 68-76 |
| Milwaukie High | Latin/Comb. | -.006 | 370 | NS | 69-76 |
| | Geom. /Comb. | -.054 | 1158 | NS | 72-29 |
| | Gen. Math/Comb | .027 | 882 | NS | 72-80 |

### Phase II
### Test Scores vs. Dry Bulb Temperature
### Climate Controlled Schools

| School | Class | r | df | P<. | Range(°F) |
|---|---|---|---|---|---|
| Powell Valley Grade | All Period 5 Combined | .111 | 553 | .01 | 73-77 |
| Ogden Junior High | Spanish/Comb. | -.151 | 307 | .01 | 74-75 |
| | Social/Comb. | .121 | 1120 | .01 | 73-76 |
| Rex Putnam High | Latin/Comb. | -.177 | 373 | .01 | 70-73 |
| | Geom. /Comb. | .345 | 412 | .01 | 72-76 |
| | Gen. Math/Comb | .252 | 328 | .01 | 72-74 |

# APPENDIX VI

## Results of Correlations between Thermal Comfort Ratings and Test Performance Measures

## Phase I and Phase II

### Phase I
### Test Scores vs. Comfort Rating
### Non-Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P<. |
|---|---|---|---|---|---|
| Gardiner Junior High | Spanish/1 (W) | F&M | .039 | 162 | NS |
| | Social/6 (B) | F&M | -.028 | 248 | NS |
| Milwaukie High | Latin I/5 | F&M | -.221 | 102 | .05 |
| | Geom. /5 | F&M | -.368 | 209 | .01 |

### Phase I
### Test Scores vs. Comfort Rating
### Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P<. |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (N) | F&M | -.090 | 180 | NS |
| Ogden Junior High | Social/2 (S) | F&M | -.051 | 210 | NS |
| | Spanish/7 (W) | F&M | .086 | 78 | NS |
| Rex Putnam High | Latin III/1 | F&M | .022 | 191 | NS |
| | Latin/8 | F&M | .172 | 73 | NS |

## Phase II
## Test Scores vs. Comfort Rating
## Non-Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P<. |
|---|---|---|---|---|---|
| East Gresham Grade | Spelling/5 (C) | F | -.206 | 44 | N.S. |
| | Spelling/5 (C) | M | .078 | 68 | N.S. |
| | Spelling/5 (H) | F | .021 | 64 | N.S. |
| | Spelling/5 (H) | M | -.084 | 72 | N.S. |
| | Spelling/5 (S) | F | -.154 | 60 | N.S. |
| | Spelling/5 (S) | M | .008 | 98 | N.S. |
| | Period 5 Comb. | F | -.104 | 172 | N.S. |
| | Period 5 Comb. | M | -.058 | 242 | N.S. |
| Gardiner Junior High | Spanish/1 (W) | F | -.241 | 18 | N.S. |
| | Spanish/1 (W) | M | .335 | 33 | .05 |
| | Social/1 (A) | F | -.146 | 40 | N.S. |
| | Social/1 (A) | M | -.107 | 56 | N.S. |
| | Social/1 (B) | F | .051 | 73 | N.S. |
| | Social/1 (B) | M | -.160 | 78 | N.S. |
| | Period 1 Comb. | F | -.049 | 135 | N.S. |
| | Period 1 Comb. | M | -.040 | 171 | N.S. |
| | Spanish/2 (W) | F | .414 | 15 | N.S. |
| | Spanish/2 (W) | M | -.188 | 24 | N.S. |
| | Social/2 (A) | F | -.034 | 37 | N.S. |
| | Social/2 (A) | M | -.011 | 98 | N.S. |
| | Social/2 (B) | F | -.032 | 84 | N.S. |
| | Social/2 (B) | M | .114 | 89 | N.S. |
| | Period 2 Comb. | F | -.036 | 140 | N.S. |
| | Period 2 Comb. | M | .032 | 215 | N.S. |
| | Spanish/3 (W) | F | .030 | 60 | N.S. |
| | Spanish/3 (W) | M | -.201 | 44 | N.S. |
| Milwaukie High | Latin/1 | F | .032 | 90 | N.S. |
| | Latin/1 | M | .091 | 49 | N.S. |
| | Gen. Math/1 | F | -.007 | 115 | N.S. |
| | Gen. Math/1 | M | .040 | 78 | N.S. |

## Phase II
## Test Scores vs. Comfort Rating (Continued)
## Non-Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P<. |
|---|---|---|---|---|---|
| Milwaukie High (continued) | Geom. /1 | F | -.044 | 115 | N.S. |
| | Geom. /1 | M | .129 | 95 | N.S. |
| | Period 1 Comb. | F | .014 | 324 | N.S. |
| | Period 1 Comb. | M | .040 | 226 | N.S. |
| | LatinIII/4 | F | -.029 | 36 | N.S. |
| | Latin III/4 | M | -.079 | 43 | N.S. |
| | Geom. /4 | F | .264 | 118 | .01 |
| | Geom. /4 | M | .033 | 119 | N.S. |
| | Period 4 Comb. | F | .208 | 156 | .01 |

## Phase II
## Test Scores vs. Comfort Rating
## Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P<. |
|---|---|---|---|---|---|
| Powell Valley Grade | Spelling/5 (N) | F | .040 | 87 | N.S. |
| | Spelling/5 (N) | M | .247 | 84 | .05 |
| | Spelling/5 (S) | F | .052 | 120 | N.S. |
| | Spelling/5 (S) | M | -.061 | 57 | N.S. |
| | Spelling/5 (J) | F | .037 | 108 | N.S. |
| | Spelling/5 (J) | M | -.067 | 71 | N.S. |
| | Period 5 Comb. | F | -.016 | 319 | N.S. |
| | Period 5 Comb. | M | .064 | 216 | N.S. |
| Ogden Junior High | Spanish/5 (W) | F | .123 | 28 | N.S. |
| | Spanish/5 (W) | M | .036 | 42 | N.S. |
| | Social/5 (R) | F | -.048 | 70 | N.S. |
| | Social/5 (R) | M | -.032 | 68 | N.S. |
| | Social/5 (S) | F | -.099 | 50 | N.S. |
| | Social/5 (S) | M | .097 | 65 | N.S. |
| | Period 5 Comb. | F | -.074 | 152 | N.S. |
| | Period 5 Comb. | M | .037 | 179 | N.S. |

## Phase II
## Test Scores vs. Comfort Rating (Continued)
## Climate Controlled Schools

| School | Class/Per. | Sex | r | df | P< . |
|---|---|---|---|---|---|
| Ogden Junior High (continued) | Spanish/6 (W) | F | -.024 | 71 | N.S. |
| | Spanish/6 (W) | M | -.058 | 42 | N.S. |
| | Social/6 (R) | F | .152 | 37 | N.S. |
| | Social/6 (R) | M | -.042 | 94 | N.S. |
| | Social/6 (S) | F | -.004 | 37 | N.S. |
| | Social/6 (S) | M | .075 | 72 | N.S. |
| | Period 6 Comb. | F | .055 | 150 | N.S. |
| | Period 6 Comb. | M | .017 | 210 | N.S. |
| Rex Putnam High | Latin/1-3 | F | .120 | 46 | N.S. |
| | Latin/1-3 | M | .214 | 64 | N.S. |
| | Latin/10-12 | F | .144 | 43 | N.S. |
| | Latin/10-12 | M | -.044 | 88 | N.S. |
| | Geom. /22-24 | F | .155 | 53 | N.S. |
| | Geom. /22-24 | M | -.001 | 145 | N.S. |
| | Math/22-24 | F | .100 | 27 | N.S. |
| | Math/22-24 | M | .050 | 129 | N.S. |
| | Latin/25-27 | F | .158 | 67 | N.S. |
| | Latin/25-27 | M | -.068 | 38 | N.S. |
| | Geom. /25-27 | F | -.025 | 100 | N.S. |
| | Geom. /25-27 | M | .138 | 92 | N.S. |
| | Math/25-27 | F | -.199 | 73 | N.S. |
| | Math/25-27 | M | -.084 | 80 | N.S. |

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